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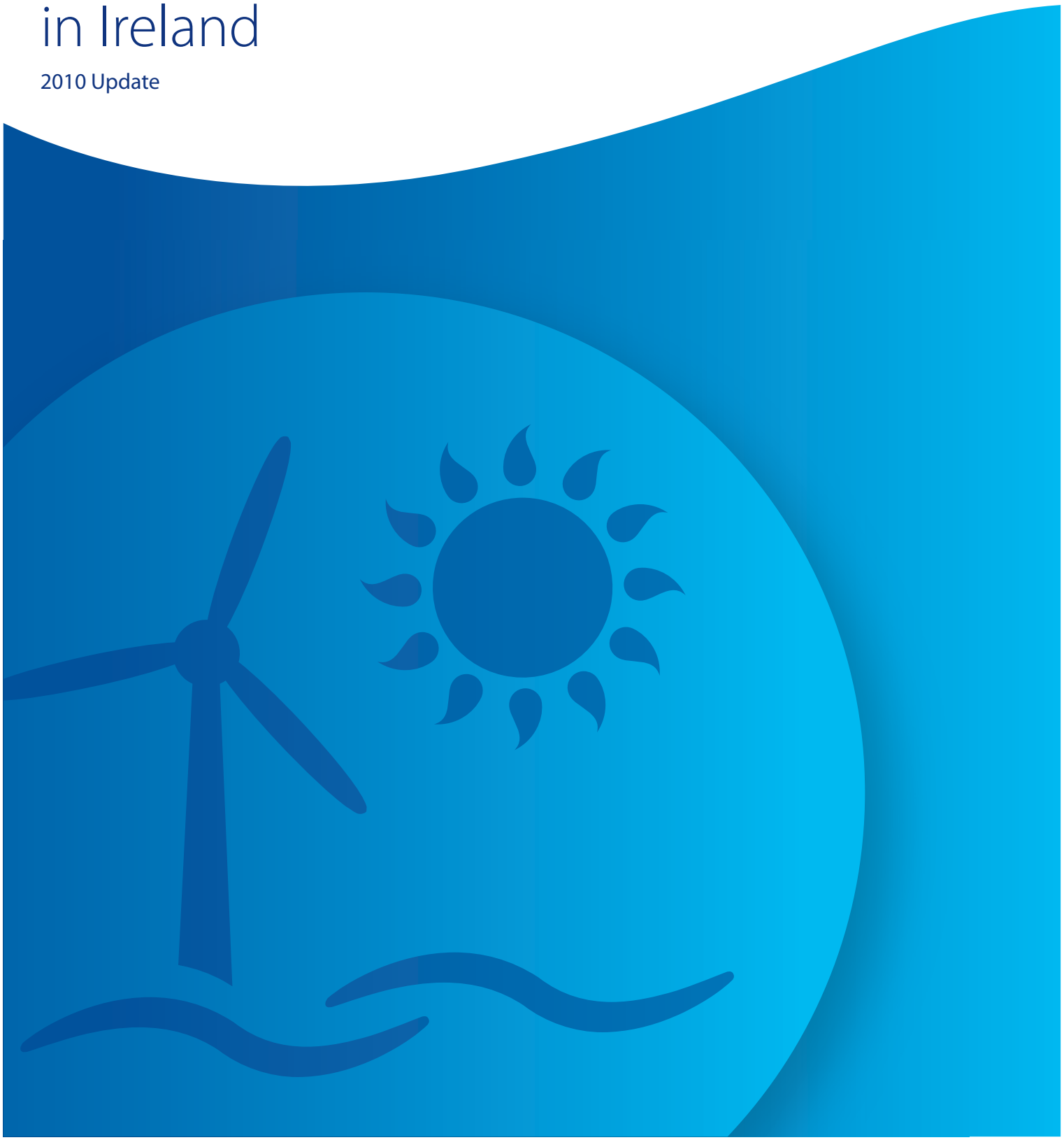
Renewable Energy in Ireland

2010 Update



Renewable Energy in Ireland

2010 Update

Report prepared by
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May 2010

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The Sustainable Energy Authority of Ireland

The Sustainable Energy Authority of Ireland was established as Ireland's national energy authority under the Sustainable Energy Act 2002. SEAI's mission is to play a leading role in transforming Ireland into a society based on sustainable energy structures, technologies and practices. To fulfil this mission SEAI aims to provide well-timed and informed advice to Government and deliver a range of programmes efficiently and effectively, while engaging and motivating a wide range of stakeholders and showing continuing flexibility and innovation in all activities. SEAI's actions will help advance Ireland to the vanguard of the global green technology movement, so that Ireland is recognised as a pioneer in the move to decarbonised energy systems.

SEAI's key strategic objectives are:

- Energy efficiency first – implementing strong energy efficiency actions that radically reduce energy intensity and usage
- Low carbon energy sources – accelerating the development and adoption of technologies to exploit renewable energy sources
- Innovation and integration – supporting evidence-based responses that engage all actors, supporting innovation and enterprise for our low-carbon future

The Sustainable Energy Authority of Ireland is financed by Ireland's EU Structural Funds Programme co-funded by the Irish Government and the European Union.

Energy Policy Statistical Support Unit (EPSSU)

SEAI has a lead role in developing and maintaining comprehensive national and sectoral statistics for energy production, transformation and end use. This data is essential for meeting international reporting obligations, advising policy makers and informing investment decisions. Based in Cork, EPSSU is SEAI's specialist statistics team. Its core functions are to:

- Collect, process and publish energy statistics to support policy analysis and development in line with national needs and international obligations
- Conduct statistical and economic analyses of energy services sectors and sustainable energy options
- Contribute to the development and promulgation of appropriate sustainability indicators

Highlights

Renewable Electricity (RES-E)

- The share of electricity generated from renewable energy sources (RES-E) in 2009 was 14.4% (provisional), exceeding the interim EU target of 13.2% RES-E by 2010 and placing Ireland firmly on track to meet the Government target of 15% of all electricity generation to be from renewable energy sources by 2010.
- Wind energy accounted for over 10% of all electricity generation in 2009.
- The installed wind capacity as of 12 January 2010 was 1,264 MW contributing to the overall renewable capacity of 1,441 MW.

Renewable Heat Energy (RES-H)

- Renewable heat (RES-H) accounted for 3.6% of all thermal energy in 2008. RES-H grew from 2.6% in 1990 to 3.8% in 2004 but has not grown significantly since, indicating a gap to the short-term Government target of 5% RES-H by 2010.
- Industrial biomass energy use (mostly in the wood and food sectors) accounted for 70% of all thermal renewable energy used in 2008, which corresponds to 2.8% of all thermal energy use in Ireland.
- Industrial biomass energy use increased by 106% (3.9% average annual growth) between 1990 and 2008. However there has been a decrease in industrial RES-H recently with an average annual reduction of 5.6% since 2005.
- Residential biomass energy use increased by 9.5% between 1990 and 2008 (0.5% average annual growth). However the average annual growth rate between 2005 and 2009 was 18%.

Renewable Transport Energy (RES-T)

- Biofuels accounted for 1.2% of road transport consumption in 2008. Provisional 2009 data estimates biofuels at 1.5% of road transport, indicating the scale of the challenge to meet the Government target of 3% RES-T by 2010.
- The Government target for RES-T of 2% by 2008 was not achieved despite the considerable growth since 2005.
- The dominant biofuel is biodiesel, representing 63% of biofuel usage in 2008, followed by bioethanol (32%) and finally pure plant oil (5%).
- Indigenous production accounted for 43% of biofuels used or stockpiled in 2008.

Energy Security

- Renewable energy accounted for 35% of indigenous energy production in 2008.
- In absolute terms the total final consumption of renewables doubled between 2003 and 2008 (20% annual average growth), largely due to the increasing contribution from wind energy.

Avoided CO_2 Emissions

- CO_2 avoided through renewable energy use increased by 257% (7.3% per annum on average) over the period 1990 to 2008 reaching 2,830 kt CO_2 in 2008.
- Wind energy use gave rise to the largest avoidance of emissions in 2008 (46%) followed by solid biomass and hydro.

Progress Towards Overall Renewable Energy Directive Target

- The contribution of renewable energy to overall energy demand rose from 2.3% to 3.9% between 1990 and 2008. The provisional 2009 figure is 4.7% and Ireland's target is to achieve 16% by 2020 under Directive (2009/28/EC).
- Renewable electricity contributed 2.2% to the Directive target in 2008 (2.8% in 2009). Renewable transport energy contributed 0.4% in 2008 (0.5% in 2009) and the renewable heat contribution was 1.4% in 2008 (1.6% in 2009).

Table of Contents

1. Introduction 6
2. Context for Renewable Energy Deployment 7
   - 2.1 Primary Energy 7
   - 2.2 Energy Demand 9
   - 2.3 Gross Final Consumption 9
   - 2.4 Primary Energy Equivalent 10
3. Renewable Energy – the Policy Context 11
   - 3.1 EU Directive (2009/28/EC) 11
     - 3.1.1 National Renewable Energy Action Plan (NREAP) 12
   - 3.2 Energy White Paper – Delivering a Sustainable Energy Future for Ireland 12
   - 3.3 National Climate Change Strategy 12
   - 3.4 Energy Efficiency 12
4. Progress Towards Targets 13
   - 4.1 Renewable Electricity (RES-E) 17
   - 4.2 Renewable Transport Energy (RES-T) 19
   - 4.3 Renewable Heat (RES-H) 21
5. Sources of Renewable Energy 23
   - 5.1 Wind – On-shore and Off-shore 23
   - 5.2 Hydro Energy 24
     - 5.2.1 Pumped Hydro Storage 25
   - 5.3 Ocean Energy – Tidal & Wave 25
     - 5.3.1 Tidal Energy 25
     - 5.3.2 Wave Energy 25
   - 5.4 Solar 25
     - 5.4.1 Photovoltaic 25
     - 5.4.2 Solar - Thermal 25
   - 5.5 Biofuels 26
   - 5.6 Combustible Renewables 26
     - 5.6.1 Solid Biomass 26
     - 5.6.2 Biogas 26
     - 5.6.3 Landfill Gas 27
   - 5.7 Wastes 27
     - 5.7.1 Industrial Waste (non-renewable) 27
     - 5.7.2 Municipal Waste 27
   - 5.8 Geothermal Energy 27
6. CO_2 Displacement 28
7. The Future of Renewables in Ireland 29
   - 7.1 Energy Forecast to 2020 29
   - 7.2 National Renewable Energy Action Plan (NREAP) 29

Glossary of Terms 31
References 33
Appendix 1. Primary Energy Equivalent Methodology 36
Appendix 2. Policy Measures 37

Table of Figures

Figure 1 Total Primary Energy Requirement 1990 to 2009 7
Figure 2 Renewable Energy Contribution to TPER 8
Figure 3 Total Final Consumption by Fuel 9
Figure 4 Primary Energy (PE) and Primary Energy Equivalent (PEE) for Wind and Hydro 10
Figure 5 Renewable Energy Share of TPER - Primary Energy and Primary Energy Equivalent 2008 10
Figure 6 Renewable Energy (%) Contribution to Gross Final Consumption (Directive 2009) 13
Figure 7 Renewable Energy (ktoe) Contribution to GFC (Directive 2009) 14
Figure 8 Renewable Energy (%) Contribution to GFC by Mode 14
Figure 9 Renewable Energy (ktoe) Contribution to GFC by Mode 16
Figure 10 Gross Electricity Consumption by Fuel Source 17
Figure 11 Renewable Energy (%) Contribution to Gross Electricity Consumption by Source 18
Figure 12 Renewable Energy Contribution (GWh) to Gross Electricity Consumption by Source 19
Figure 13 Renewable Energy as a Proportion of Road Transport Energy 20
Figure 14 Electricity Generated by Wind 23
Figure 15 Installed Wind Generating Capacity 2000 - 2009 24
Figure 16 Biofuels Production, Imports and Usage (2008) 26
Figure 17 Avoided CO_2 from Renewable Energy 1990 to 2008 28
Figure 18 Renewable Energy Contribution to TFC (White Paper Scenario) 29

Table of Tables

Table 1 Growth Rates and Shares of TPER Fuels 8
Table 2 Renewable Energy Progress to Targets 15
Table 3 Renewable Energy (ktoe) Contribution to GFC by Mode 16
Table 4 Gross Electricity Consumption Percentage by Fuel Source 17
Table 5 Renewable Electricity as Percentage of Gross Electricity Consumption 18
Table 6 Installed Electricity Generation Capacity – Renewables 19
Table 7 Biofuels Growth in ktoe and as a Proportion of Road Transport Energy 20
Table 8 Trends in Renewable Thermal Energy (RES-H) by Sector 21
Table 9 Trends in Renewable Thermal Energy (RES-H) by Sector 22
Table 10 Renewable Electricity Production – Wind 23
Table 11 Relative Price Increase Due To the Carbon Tax 37
Table 12 REFIT Scheme Support Levels 38

1. Introduction

Developing renewable energy is an integral part of Ireland's sustainable energy objectives and climate change strategy. Renewable energy contributes to meeting all three energy policy goals, namely; energy security, cost competitiveness and protection of the environment through the reduction of greenhouse gas (GHG) emissions. With lower or no net emissions from renewable energy sources compared to fossil fuels, renewable energy sources contribute of the decarbonisation of the energy supply and reduction in greenhouses gases emissions. They also contribute to energy security, being, for the most part, an indigenous energy source. In a period of increasing and volatile energy costs renewables can also contribute to cost competitiveness by reducing dependence on imported fossil fuels. There is the potential for Ireland to become a net exporter of renewable energy and technology. The ambition is for Ireland to become a globally recognised centre of expertise in the development and integration of renewable energy technologies.

This report examines the contribution made by renewables to Ireland's energy requirements for the period 1990 to 2008, with a particular focus on production data in 2008, and introduces provisional 2009 data. Capacity data are available for 2009 and early 2010. This is the fourth in a planned series of updates and follows the Renewable Energy in Ireland 2008 Report[1], which focused on wind energy and biofuels. This report also contains data in relation to waste energy to reflect the submission to the IEA/Eurostat annual survey on renewables and waste and the growing contribution of wastes to Ireland's energy supply. The energy from wastes currently used in Ireland (landfill gas, sewage sludge gas, wood wastes, tallow and meat and bone meal) are all classified as renewable sources of energy.

Wastes are a growing source of energy, notwithstanding that policy for waste management[2] in Ireland is based on the international hierarchy of options, namely: prevention, minimisation, reuse, recycling, energy recovery and the environmentally sustainable disposal of residual waste. Benefits of using wastes for energy include the diversion from landfill, and a reduction in greenhouse gas emissions in most cases. Wastes also contribute to enhancing cost competitiveness and energy security. However there is the fear that some waste to energy solutions prejudice the achievement of recycling objectives and there are health concerns associated with some forms of energy recovery, e.g. incineration.

This report also discusses the progress towards national and EU renewable targets and provides an overview of the status of all renewables and wastes currently used in Ireland. The progress towards short term targets (2010) is significant as the National Renewable Energy Action Plan (NREAP), which will outline how to achieve Ireland's 2020 renewable energy targets, is due for submission in June 2010.

The report is structured as follows:

- Section 2 provides the context for renewable energy deployment, examining the recent trends in primary energy usage.
- Section 3 summarises the policy measures which have been announced to increase renewable energy penetration.
- Section 4 analyses the progress towards the various renewable energy targets.
- Section 5 assesses the status of the various renewable energy sources and waste fuels used in Ireland's energy mix.
- Section 6 estimates the extent of avoided carbon dioxide emissions arising from the use of renewables.
- Finally, section 7 looks at the future of renewable energy in Ireland through energy forecasts and the National Renewable Energy Action Plan.

The national energy balance data presented in this report are the most up-to-date at the time of writing. Balance data are updated whenever more accurate information is known. The most up-to-date balance figures are available in the statistics publications section of the Sustainable Energy Authority of Ireland's website. An energy data service is available at http://www.seai.ie/statistics; follow the links for Energy Statistics Databank. This service is hosted by the Central Statistics Office with data provided by SEAI. The 2009 balance data used are from the provisional balance as released on 31 March 2010.

Feedback and comment on the report are welcome and should be addressed by post to the address on the back cover or by email to epssu@seai.ie.

1 Available from http://www.seai.ie/Publications/Statistics_Publications/EPSSU_Publications/

2 Department of the Environment (2004), *Waste Management - Taking Stock and Moving Forward*. Available from http://www.environ.ie/en/Environment/Waste/

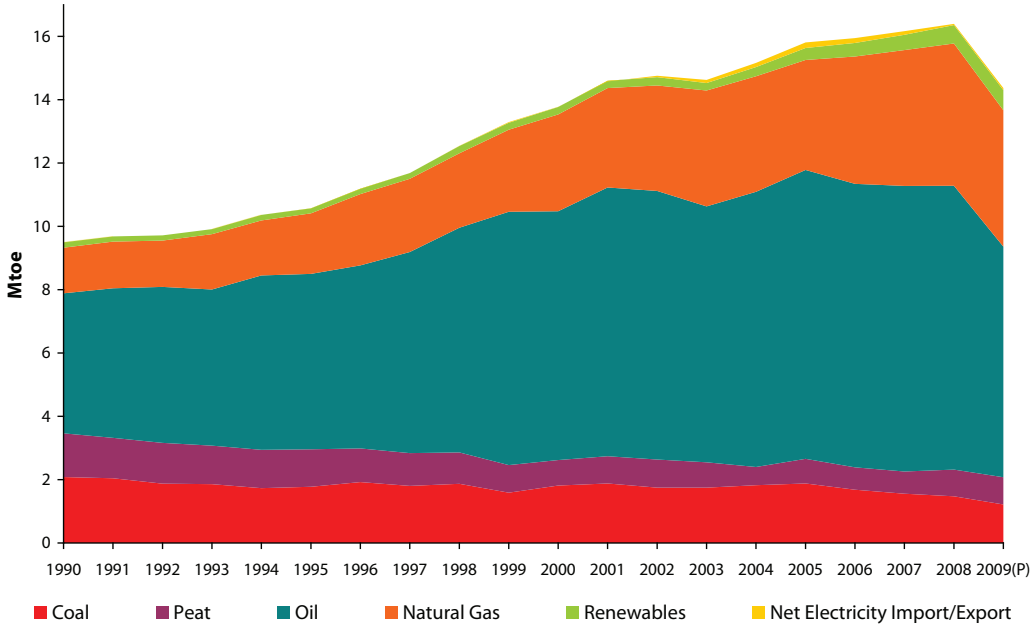
2. Context for Renewable Energy Deployment

2.1 Primary Energy

Ireland's overall energy supply is discussed in terms of changes to the total primary energy requirement (TPER), defined as the total amount of energy used within Ireland in any given year. This includes the energy requirements for the conversion of primary sources of energy into forms that are useful for the final consumer, for example electricity generation and oil refining. These conversion activities are not all directly related to the level of economic activity that drives energy use but are dependent to a large extent, as in the case of electricity, on the efficiency of the transformation process and the technologies involved.

Figure 1 illustrates the trend in energy supply over the period 1990 to 2008 with provisional 2009 data, emphasising changes in the fuel mix. Primary energy requirement in Ireland in 2008 was 16.4 million tonnes of oil equivalent (Mtoe). Over the period 1990 – 2008 Ireland's total annual primary energy requirement grew in absolute terms by 72% (average annual growth rate of 3.1%). In 2008 Ireland's primary energy requirement increased by 1.2%. The individual fuel growth rates and shares are shown in Table 1.

Figure 1 Total Primary Energy Requirement 1990 to 2009[3]



Source: SEAI

Provisional 2009 data show a 12.4% reduction in primary energy requirement. All fuels experienced a reduction with the exception of peat which increased by 1.3% and renewables which increased by 9%.

The significant increase in overall TPER over the period 1990 - 2008 masks the fact that renewable energy has grown considerably in absolute terms since the mid 1990s. Total renewable energy grew, in absolute terms, from 168 ktoe to 581 ktoe between 1990 and 2008, an increase of 247% (7.1% per annum on average) over the period. The increase in 2007 was 12% and 21% in 2008 (9% in 2009).

3 The 2009 energy balance data throughout this report is provisional data. Such data is marked throughout the tables and figures as 2009(P).

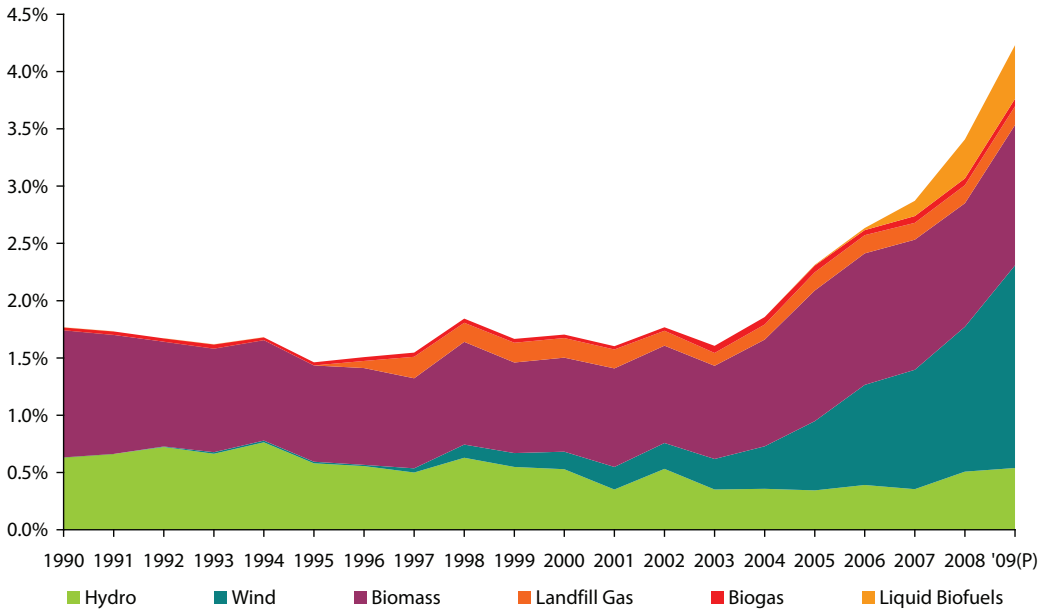
Table 1 Growth Rates and Shares of TPER Fuels

	Growth %	Average annual growth rates %						Shares %	
	1990 – '08	1990 – '08	1990 – '95	1995 – '00	2000 – '05	2005 – '08	2008	1990	2008
Fossil Fuels (Total)	68.7	2.9	2.2	5.4	2.4	1.1	1.4	98.2	96.2
Coal	-31.1	-2.1	-3.1	0.4	0.2	-7.8	-4.8	22.0	8.8
Peat	-38.7	-2.7	-3.0	-7.5	-0.7	2.9	20.4	14.5	5.2
Oil	102.7	4.0	4.6	7.3	3.0	-0.6	-0.6	46.6	54.8
Natural Gas	210.6	6.5	5.8	9.8	2.6	8.9	4.6	15.2	27.5
Renewables (Total)	246.5	7.1	-1.6	8.7	9.8	15.6	20.9	1.8	3.6
Hydro	38.9	1.8	0.5	3.5	-5.7	15.3	45.3	0.6	0.5
Wind	-	-	-	72.4	35.4	29.4	23.1	0.0	1.3
Electricity Imports	-	-	-	53.2	64.7	-28.3	-46.7	0.0	0.4
Total	72.2	3.1	2.2	5.4	2.7	1.2	1.5		

Source: SEAI

As shown in Figure 2, renewable energy has been contributing nearly 2% of Ireland's primary energy supply between 1990 and 2004. In 2004 the contribution stood at 1.9% and this increased to 2.9% in 2007 and 3.6% in 2008. The provisional 2009 data puts the renewable contribution to TPER at 4.4%.

Figure 2 Renewable Energy Contribution to TPER



Source: SEAI

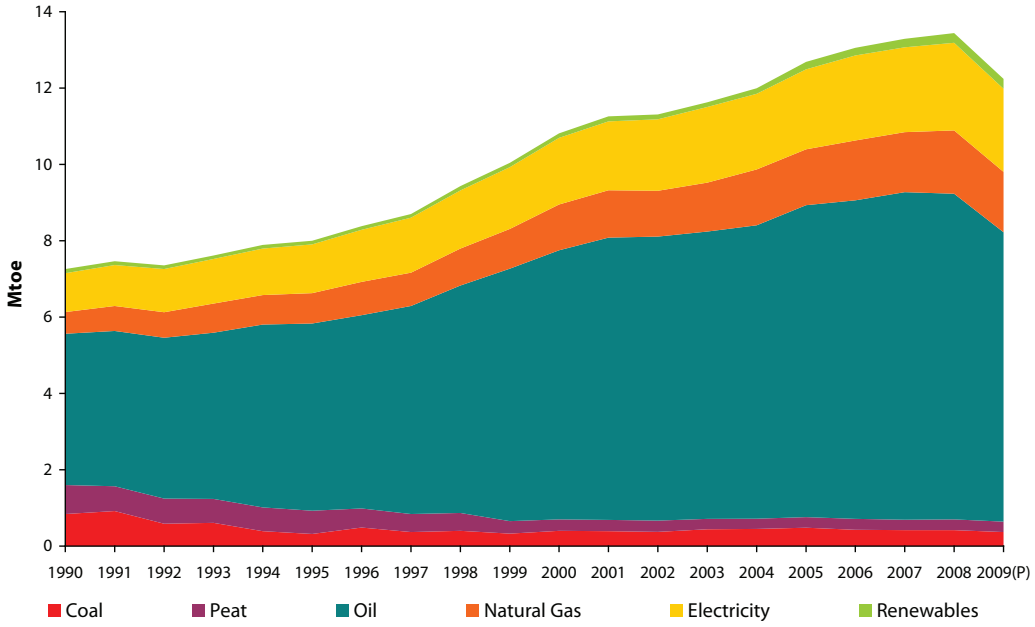
There are many different indicators spoken about in relation to the share of renewables in energy use and the figure of 3.6% renewable contribution to primary energy in 2008 should not be confused with others that relate to specific targets or measures. This variety of indicators has come about to measure progress against various measures and targets — national, EU and global. Care must be taken when assessing these targets to use the correct indicator. For instance, the indicative target for Ireland in the Renewable Energy Directive is a 13.2% share of gross electricity consumption by 2010. The national target specified in the 2007 Government *Energy White Paper — Delivering a Sustainable Energy future for Ireland*[4] is 15% by 2010 and 33% by 2020. In the Carbon Budget of October 2008 the 2020 target was extended from 33% to 40%. The EU Directive (2009/28/EC) on the promotion of renewable energy has a mandatory target of 16% of gross final consumption to come from renewable energy by 2020. These targets are discussed in Sections 3 & 4 and as appropriate throughout the report.

4 The full text of the White Paper is available at http://www.dcenr.gov.ie/Energy/Energy+Planning+Division/Energy+White+Paper.htm

2.2 Energy Demand

Final energy demand is a measure of the energy that is delivered to energy end users in the economy to undertake activities as diverse as manufacturing, movement of people and goods, essential services and other day-to-day energy requirements of living. This is also known as Total Final Consumption (TFC) and is essentially total primary energy less the quantities of energy required to transform primary sources such as crude oil into forms suitable for end use consumers such as refined oils, electricity, patent fuels etc. (Transformation, processing or other losses entailed in delivery to final consumers are known as "energy overhead".) Figure 3 shows the shift in the pattern of final energy demand by fuel over the period 1990 to 2008 with provisional 2009 data.

Figure 3 Total Final Consumption by Fuel



Source: SEAI

Ireland's TFC in 2008 was 13.4 Mtoe, an increase of 1.2% on 2007 and 85% above 1990 levels (representing an average growth rate of 3.5% per annum). Final consumption of renewable energy increased by 134% (4.8% per annum on average) from 1990 to 2008. Renewable energy sources experienced the highest growth in final consumption of all fuels in 2008, growing by 15%. Provisional 2009 data shows a decrease of 8.9% in final energy consumption. Final consumption of all fuels decreased with the exception of renewable energy which grew by 2.4%.

2.3 Gross Final Consumption

In order to facilitate international comparisons of renewable energy it is necessary to set transparent and unambiguous rules for calculating the share of energy from renewable sources and for defining those sources across all countries. In the EU Renewable Energy Directive (2009/28/EC)[5] the renewable energy share is calculated from the gross final consumption of energy. The definition of gross final consumption of energy (GFC) is the energy delivered for energy purposes including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution.

- GFC = TFC (Transport) + GFC (Elec) + GFC(Heat)

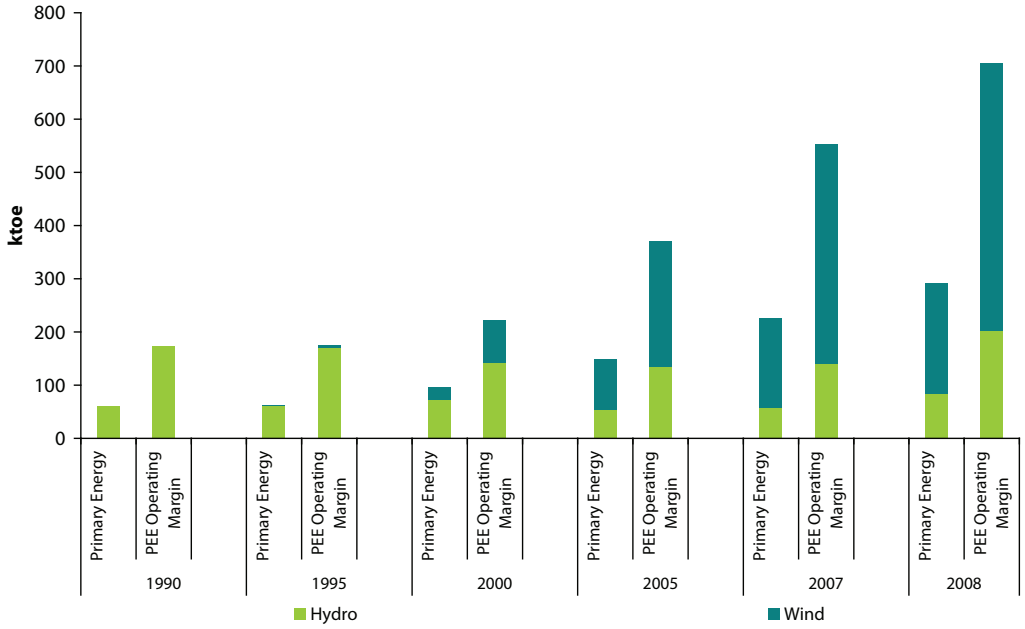
In the case of electricity for example, the difference between total final consumption (TFC) and gross final energy consumption (GFC) is that TFC equates with all electricity demand used by customers, whereas GFC includes the transmission and distributions losses and the in-house use of electricity by electricity generators.

5 European Union, 2009. Directive 2009/28/EC. Available from http://europa.eu/legislation_summaries/energy/renewable_energy/en0009_en.htm

2.4 Primary Energy Equivalent

The methodology for calculating the Primary Energy Equivalent (PEE) described in Appendix 1. Based on this analysis the PEE (Operating Margin) for non-combustible renewable energy (wind and hydro) is compared with the primary energy (PE) values in Figure 4 at five-year intervals since 1990 and also for 2007 and 2008. The difference between the PE and PEE is particularly noticeable and also the increasing importance of wind. Focusing on the year 2008, the PEE for wind and hydro was almost 2.5 times larger (143%) than their primary energy.

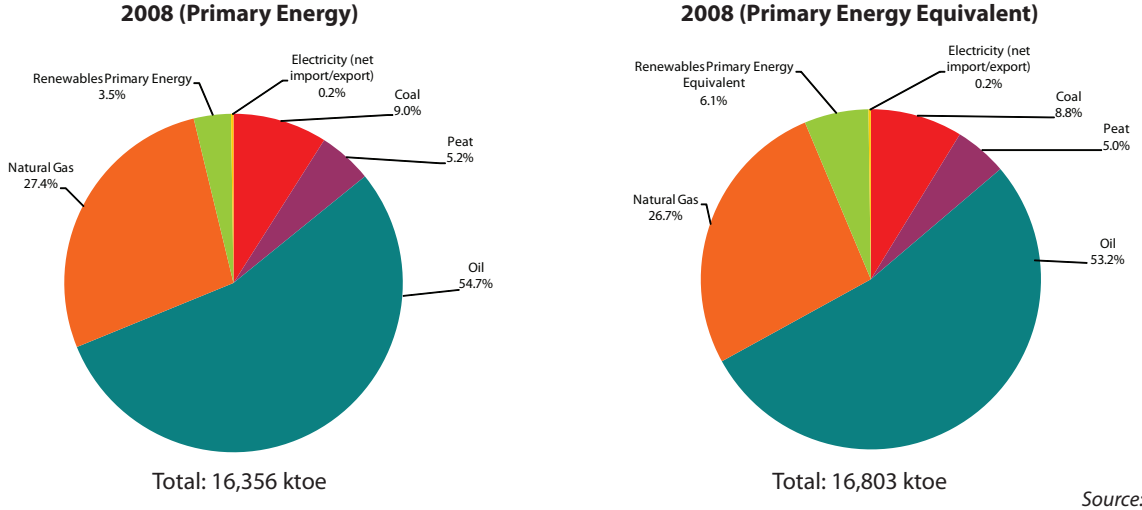
Figure 4 Primary Energy (PE) and Primary Energy Equivalent (PEE) for Wind and Hydro



Source: SEAI

The total PEE for renewable energy is then calculated by adding the primary energy for combustible renewable sources to the calculated PEE for non-combustible renewables. This provides a new measure of renewable energy's contribution to energy supply. The total PEE for renewable energy increased from 281 ktoe in 1990 to 1028 ktoe in 2008, an increase of 266% (7.5% per annum on average). The increase in 2008 was 24% (9.4% in 2007). Figure 5 compares the contribution of renewable energy to TPER using the traditional PE method and the PEE approach. Renewable energy accounted for 3.6% of TPER in 2008 (1st pie chart in Figure 5). Using the PEE approach it can be seen (2nd pie chart in Figure 5) that the contribution to TPER is 6.1%.

Figure 5 Renewable Energy Share of TPER - Primary Energy and Primary Energy Equivalent 2008



Source: SEAI

3. Renewable Energy – the Policy Context

Irish renewable energy policy is framed in the context of European and other international targets. As seen in section 2 over the period 1990 to 2008 the total primary energy requirement (TPER) for Ireland increased by 72% (3.1% per annum on average) while renewable energy increased by 247% (7.1% per annum). The share of renewables in TPER doubled to 3.6% in 2008 (1.8% in 1990). There is clearly further scope for renewables to contribute to Ireland's increasing demand for energy and a clear motive for policy makers to put in place programmes and measures to increase this share. This section outlines the key policy targets relevant to renewable energy use in Ireland. Existing policy measures which relate to renewable energy are listed in Appendix 2.

3.1 EU Directive (2009/28/EC)

In June 2009 the European Commission published EU Directive (2009/28/EC) on the promotion of the use of energy from renewable sources and amending and subsequently repealed Directives (2001/77/EC)[6] and (2003/30/EC)[7]. Directive (2001/77/EC) provided the framework for the integration of renewable electricity sources into the electricity grid, while Directive (2003/30/EC) promoted the use of biofuels and renewables in transport energy. The 2010 targets from the earlier directives remain in force until the end of 2011. However any other overlaps with Directive (2009/28/EC) will be deleted following transposition of this Directive, which must be implemented by 5 December 2010.

The EU Directive (2009/28/EC) lays down that:

- Mandatory national targets should be established consistent with a 20% share of energy from renewable sources in Community energy consumption by 2020. This is consistent with the EU Climate and Energy package[8] renewables target.
- The individual target for each member state should be calculated based on the share of renewables in gross final consumption.
- Each member state must submit a national renewable energy action (NREAP) plan by June 2010.
- A mandatory national target should be established consistent with a 10% share of energy from renewable sources in transport[9] in Community energy consumption by 2020.

Ireland's overall target is 16% of gross final energy consumption to come from renewable sources by 2020 (3.1% in 2005), whereas Sweden has a target of 49% due to a higher existing percentage of renewables (39.8% in 2005). The 10% target for energy from renewable sources in transport is set at the same level for each member state. This renewable energy can be from biofuels or the renewable portion of electricity used for transport. The Directive (2009/28/EC) also establishes the sustainability criteria for biofuels and bioliquids. Transport energy from wastes, second generation biofuels and electric vehicles (EVs) are given a higher weighting than first generation biofuels for the EU RES-T target.

The EU targets for 2010 are as follows:

- An increase in the contribution of renewables to 12% of Europe's total energy by 2010.
- By 2010, the target share of renewable energy in gross electrical consumption of the EU is 22.1% from all EU 15 countries (21% for the EU (27)). The specific target for Ireland is 13.2% of electricity to come from renewables by 2010.
- The member states must ensure that the minimum share of biofuels sold on their markets is 5.75% by December 2010. Any member state setting lower objectives will have to justify this on the basis of objective criteria.

The Directive attaches an important condition to biofuels: that they must come from sustainable sources. Sustainable sources as defined by Article 17 of the Directive 2009/28/EC are:

- The greenhouse gas emission saving from the use of biofuels and bioliquids shall be at least 35%. This percentage increases to 50% by 2017 and (for new biofuel plants that start production from 1 January 2017) 60% from 2018.
- Biofuels and bioliquids shall not be made from raw material obtained from land with high biodiversity value.
- Biofuels and bioliquids shall not be made from raw material obtained from land with high carbon stock.

6 Available from http://eur-lex.europa.eu/en/index.htm
7 Ibid.
8 http://ec.europa.eu/environment/climat/climate_action.htm
9 Only petrol, diesel, biofuels consumed in road and rail transport, and electricity used for transport purposes shall be taken into account.

- Agricultural raw materials cultivated in the Community and used for the production of biofuels and bioliquids shall be obtained in accordance with the requirements and standards under the provisions referred to under the heading 'Environment' in part A and in point 9 of Annex II to Council Regulation (EC) No 73/2009.

The Irish government lowered the 2010 biofuels target for Ireland from 5.75% to 3%[10] in October 2008 due to concerns regarding the impact of global biofuels development on food prices, food security and sensitive ecosystems coupled with low greenhouse gas emissions benefits from some energy intensive biofuel production processes.

3.1.1 National Renewable Energy Action Plan (NREAP)

Each EU member state is required to submit a National Renewable Energy Action Plan by June 2010 as part of the Renewable Energy Directive (2009/28/EC). In the NREAP each member states sets out national RES-E, RES-T and RES-H targets and the steps envisaged to meet the state's mandatory EU 2020 targets. The forecasts document on which the NREAP[11] will be based was submitted in December 2009. The finalised NREAP text is due for submission on 30 June 2010.

3.2 Energy White Paper – Delivering a Sustainable Energy Future for Ireland

The Irish government in the Energy White Paper has also set individual targets for renewable energy in electricity generation (RES-E), transport (RES-T) and thermal energy (RES-H). These targets are as follows:

- Renewables contribution to gross electricity consumption of 15% by 2010 and 40%[12] by 2020.
- Renewable contribution to road transport energy (biofuels penetration) of 3% by 2010 and 10% by 2020.
- Renewable contribution to heat (thermal requirement - heating & cooling) of 5% by 2010 and 12% by 2020.

The White Paper also includes the following specific targets:

- At least 500 MW installed wave energy capacity by 2020.
- 30% biomass co-firing at three state-owned peat power generation stations by 2015.
- 400 MW of CHP, with particular emphasis on biomass CHP, by 2010 and a 2020 target of 800 MW.

3.3 National Climate Change Strategy

Strategies to reduce emissions include renewable energy as a core part of the CO_2 abatement. The details of Ireland's CO_2 abatement strategy are available in the *National Climate Change Strategy 2007 to 2013* document[13] produced by the Department of the Environment.

3.4 Energy Efficiency

Energy efficiency is seen as the enabler for renewable energy and renewable technologies. In the renewable energy Directive (2009/28/EC) energy efficiency and energy saving policies are referred to as "the most effective methods by which Member States can increase the percentage share of energy from renewable sources, and Member States will thus more easily achieve the overall national and transport targets for energy from renewable sources laid down by this Directive." Energy efficiency is examined separately in the *Energy Efficiency in Ireland 2009*[14] report.

Strategies to improve energy efficiency also include the use of renewable energy sources. The details of Ireland's energy efficiency strategy is detailed in the *National Energy Efficiency Action Plan 2009-2020 – Maximising Ireland's Energy Efficiency*[15] produced by the Department of Communications, Energy and Natural Resources.

10 Announcement by the Minister for Communications, Energy and Natural Resources on 29th September 2008. http://www.dcenr.gov.ie/Press+Releases/2008/Minister+Ryan+proposes+new+target+for+biofuels+in+Ireland.htm
11 http://ec.europa.eu/energy/renewables/transparency_platform/doc/ireland_forecast_english.pdf
12 Initially the renewable electricity target for 2020 was 33% but in the Carbon budget of 2008 this was increased to 40%. See http://www.environ.ie.
13 The full text of the National Climate Change Strategy is available at http://www.environ.ie/en/Publications/Environment/Atmosphere/
14 Available from http://www.seai.ie/Publications/Statistic_Publications/EPSSU_publications
15 The full text of the National Energy Efficiency Action Plan is available from http://www.dcenr.gov.ie/Energy/Energy+Efficiency+and+Affordability+Division/National+Energy+Efficiency+Action+Plan.htm

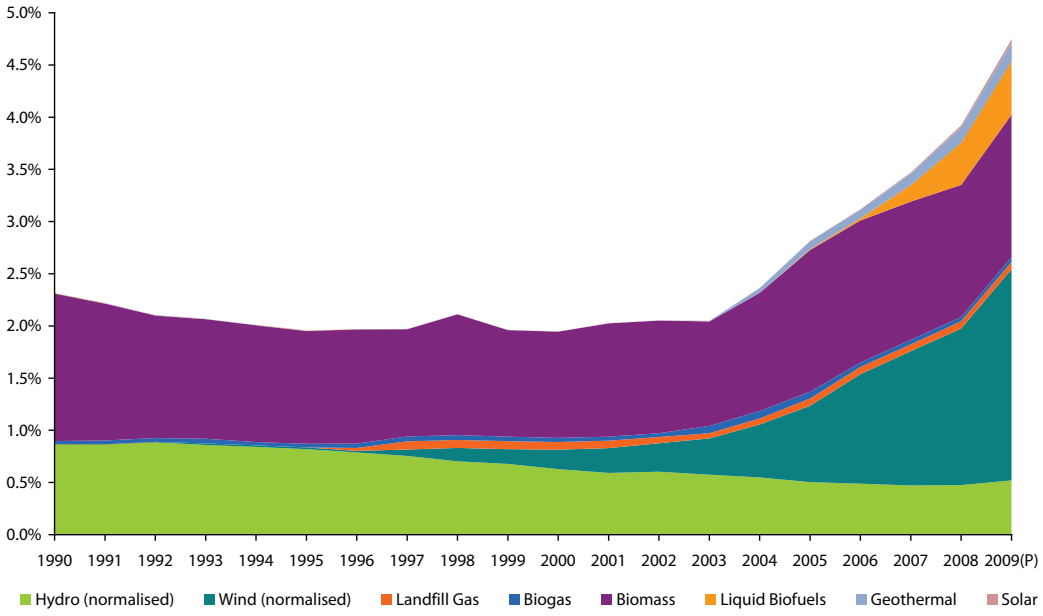
4. Progress Towards Targets

The target for Ireland in the European Renewable Energy Directive (2009/28/EC) for 2020 is for renewable sources to account for 16% of gross final energy consumption (GFC). The Directive defines gross final consumption of energy as the energy commodities delivered for energy purposes to manufacturing industry, transport, households, services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution.

The renewable energy contribution includes electricity generation, transport energy and thermal energy from renewable sources; these are termed RES-E, RES-T and RES-H respectively. Hydro and wind electricity generation are normalised for calculation of the overall renewable energy target in the Directive (2009/28/EC). Hydro electricity generation is normalised to reflect the average hydro generation of the last 15 years. Wind energy is normalised over the latest five years. The renewable electricity targets for 2010 do not require normalisation.

Figure 6 shows the contribution of renewable energy to GFC according to the definition in the Directive (2009/28/EC). The contribution in 1990 was 2.3% rising to 3.9%[16] in 2008. Provisional 2009 data puts the renewable energy contribution at 4.7%. Figure 6 shows the contribution from the various sources of renewable energy. Biomass here consists largely of wood and wood waste as thermal energy, with smaller contributions from electricity generated from biomass and biogas along with transport liquid biofuels.

Figure 6 Renewable Energy (%) Contribution to Gross Final Consumption (Directive 2009)

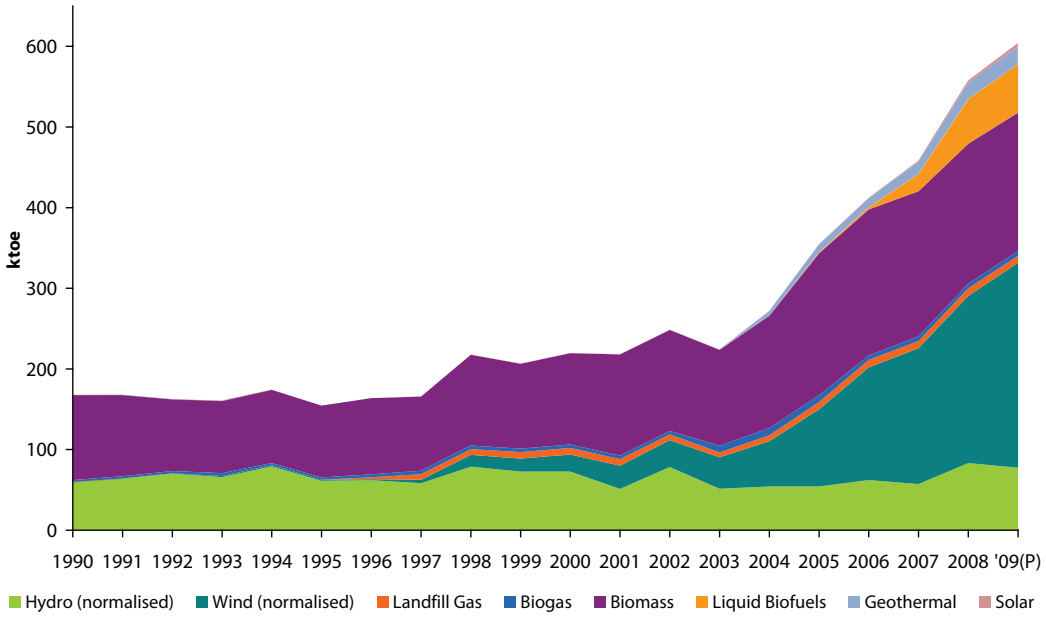


Source: SEAI

Figure 7 shows the renewable energy contributions in absolute energy terms, to illustrate the growth in each source independently of GFC growth. The more than doubling of renewable energy (from 224 ktoe to 558 ktoe) between 2003 and 2008 (20% annual average growth) is striking, due largely to the increasing contribution from wind energy. The provisional total figure for 2009 is 607 ktoe.

16 The correct figure is 3.9%; the figure of 4.5% in 2008 published in the latest Energy in Ireland report was calculated incorrectly.

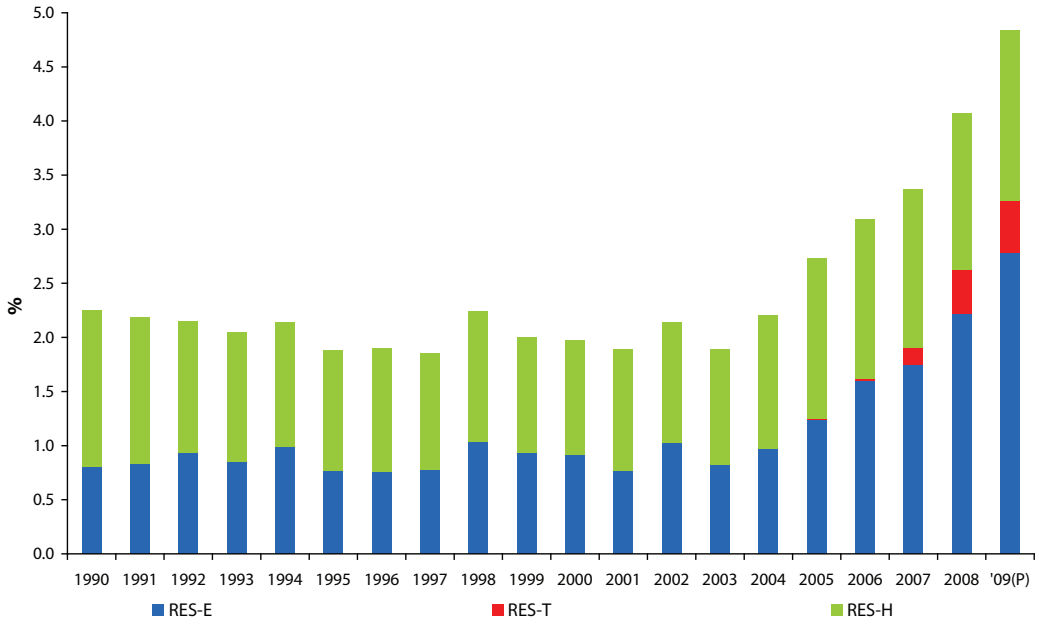
Figure 7 Renewable Energy (ktoe) Contribution to GFC (Directive 2009)



Source: SEAI

Figure 8 shows the same information as presented in Figure 6 but here the renewable contributions are distinguished in terms of each energy mode, i.e. indicating separately the contribution in energy terms to electricity (RES-E), transport (RES-T) and thermal energy (RES-H).

Figure 8 Renewable Energy (%) Contribution to GFC by Mode



Source: SEAI

The contributions to each mode are important because, in addition to the EU Directive (2009/28/EC) mandatory targets for overall renewable energy and renewable energy in transport, Ireland has national targets for 2020 that are specified in the Government White Paper on Energy for each individual mode of energy, as described in Section 3.

- RES-E 40% – electricity from renewable sources to contribute 40% to gross electricity consumption[17] by 2020, with an interim target of 15% by 2010.
- RES-H 12% – 12% of thermal energy to come from renewable sources by 2020, with an interim target of 5% by 2010.
- RES-T 10% – 10% of petrol, diesel, biofuels and electricity consumed in road and rail transport to come from renewable energy sources by 2020 (mandatory Directive target), with interim national targets (biofuels penetration) of 2% by 2008 and 3% in 2010.

The combined effect of these three modal targets, coupled with Ireland's energy efficiency targets, is anticipated (according to forecasts published in the 2009 Energy Forecast for Ireland to 2020[18]) to deliver a 16% renewable energy contribution to GFC[19], i.e. to deliver the proposed EU Directive target for Ireland. Table 2 tabulates progress towards the individual modal targets and to the overall TFC target for the period 1990 – 2008 (2009 provisional). Here the percentages in each row RES-E, RES-T and RES-H relates to the specific modal targets and the percentages in the final row relate to the overall target using the definition in the proposed EU Renewable Energy Directive.

Table 2 Renewable Energy Progress to Targets[20]

										Targets	
% of each target	1990	1995	2000	2005	2006	2007	2008	2009(P)		2010	2020
RES-E	4.9	4.1	5.0	6.8	8.6	9.4	11.9	14.4		15	40
RES-T	0.0	0.0	0.0	0.0	0.1	0.5	1.2	1.5		3	10
RES-H	2.6	2.1	2.4	3.5	3.6	3.7	3.6	3.9		5	12
Directive (2008)	**2.3**	**1.9**	**2.0**	**2.8**	**3.1**	**3.5**	**3.9**	**4.7**			**16**

Source: SEAI

The latter two columns show the targets for 2010 and 2020. This provides a sense of the scale of challenge to meet each target, and an indication of the significance of progress to date, when placed within the context of these targets. In the case of RES-E, the share of electricity from renewable energy has more than doubled between 1990 and 2008 from 4.9% to 11.9%, an increase of 7 percentage points over 17 years. Most of this increase (6.9 percentage points) took place in the past eight years since 2000. Over the two year period 2009 – 2010, a further increase in share of 3.1 percentage points is required to meet the 2010 target of 15%. The provisional 2009 data puts the RES-E figure at 14.4% and suggests that Ireland is well on track to meet this target during 2010.

As shown in Table 2, there was a significant increase in the share of transport energy from biofuels in 2007 and 2008, albeit from a low base. Biofuels accounted for 1.2% (in energy terms) of road transport energy in 2008, growing from 0.1% in 2006. The short term national target of 2% by 2008 contained in the White Paper was not achieved despite that considerable recent growth. The provisional 2009 RES-T figure of 1.5% highlights the significant challenge in meeting the 2010 target of 3%. The penetration of renewable energy in transport is planned to be accelerated by the commencement of the Biofuels Obligation Scheme. It is expected to come into operation in July 2010. The bill specifies a requirement of a 4.2% by volume (equivalent to approximately 3% in energy terms) biofuels share of all petroleum products sold for road transport energy use.

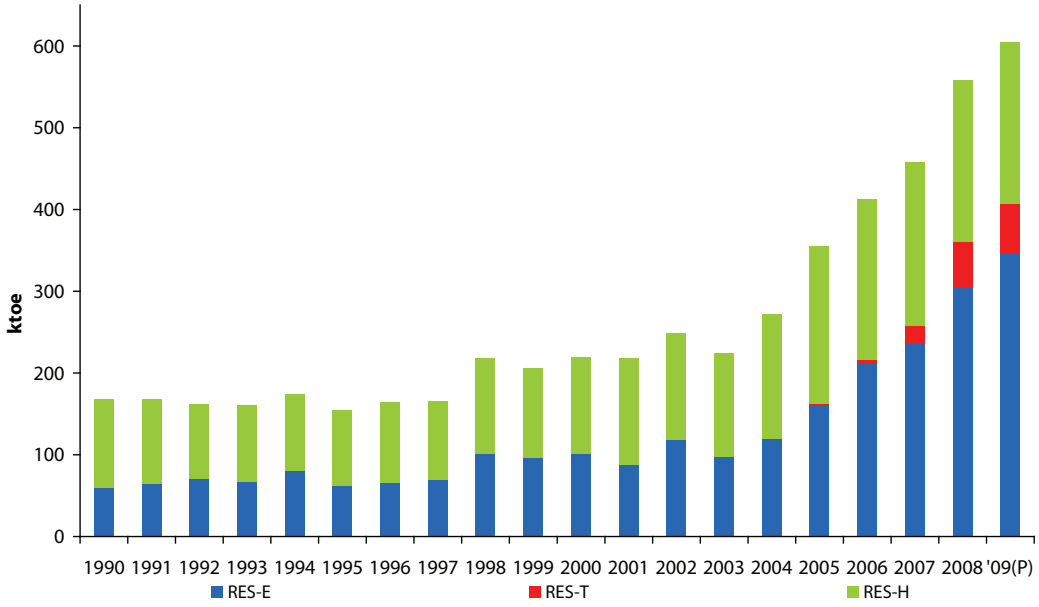
Regarding RES-H, there was a decline in the contribution from renewable energy to thermal energy in the early 1990s, from 2.6% in 1990 to 2.1% in 1995. Between 2000 and 2007 RES-H grew from 2.4% to 3.7% before falling back slightly in 2008 to 3.6%. The provisional 2009 RES-H figure is 3.9%. This growth in renewable energy (dominated by biomass) that has occurred is mostly due to increased activity in the industrial sub-sectors where the biomass is mostly used (wood and food sectors). There has also been recent growth in renewable energy use in the residential and services sectors with the introduction of grant

17 Gross electricity consumption = total electricity generated + net imports.
18 SEAI, 2009. *Energy Forecasts in Ireland to 2020* - 2009 Report available from http://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling_Group.
19 GFC (Directive) = TFC (Transport) +GFC (electricity)+ GFC(heat)
20 Note: Individual target percentages are not additive.

support schemes, but the increases here have to date been small in volume with respect to overall thermal renewable energy consumption. Against this backdrop, the short term target of achieving a 5% renewable energy contribution to Ireland's thermal energy by 2010 is very challenging.

Figure 9 and Table 3 show the contribution of renewable energy to each energy mode, presented here in absolute energy terms (ktoe) rather than as a percentage of the energy consumption for those modes. The growth in wind energy noted in Figure 7 is clearly visible here in the growth in RES-E, electricity generation from renewables. As is the recent growth in biofuel in the RES-T contribution.

Figure 9 Renewable Energy (ktoe) Contribution to GFC by Mode



Source: SEAI

Examining renewable energy data in terms of quantities of energy produced provides a different perspective than focussing on the proportions of renewable energy in each energy market i.e when energy use is classified into three distinct modes of application (markets), namely; mobility (transport), thermal uses (space or process heating) and electricity. Table 3 quantifies the absolute contributions from renewable energy to each of the energy modes or markets in Ireland. Table 3 shows that renewable energy contributed 364 ktoe to Ireland in the form of electricity in 2008 and 198 ktoe in the form of thermal energy and 56 ktoe to transport energy. The contribution from renewable energy to electricity was thus 84% higher than the renewable contribution to the thermal energy market and more than six times the contribution to the transport energy market (650% higher). This contrasts significantly with the situation in 2002, when the renewable energy contribution to thermal energy was 8% greater than the renewable contribution to electricity.

It is interesting to compare the absolute contributions of renewable energy to each market and then to re-examine Table 2 from this perspective. According to Table 2, over the period 1990 – 2008, the renewable energy share in electricity was, in every year, much higher than the renewable share of the thermal energy market. Table 3 shows however that the quantity of renewable energy produced in the form of electricity was less than that in the form of thermal energy over the period 1990 – 2005. While electricity has the largest percentage share of renewable energy, it is important to highlight that electricity is the smallest energy market (19% of gross final consumption in 2008).

Table 3 Renewable Energy (ktoe) Contribution to GFC by Mode

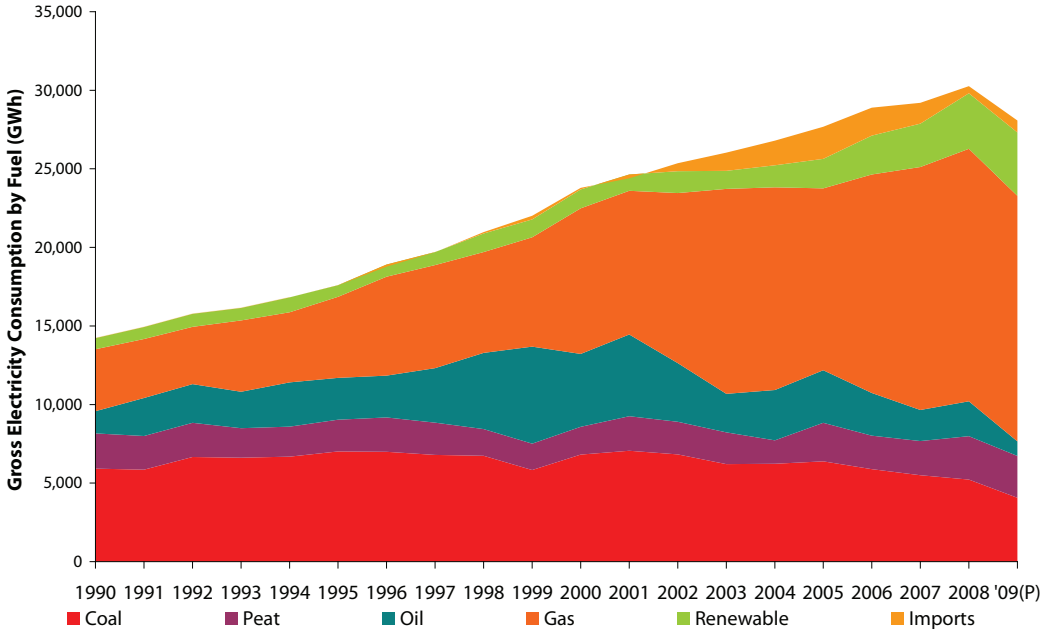
ktoe	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009(P)
RES-E	60	64	102	88	119	98	120	161	213	237	304	347
RES-T	0	0	0	0	0	0	0	1	3	21	55	64
RES-H	108	92	118	130	130	126	152	193	197	200	198	196

Source: SEAI

4.1 Renewable Electricity (RES-E)

Figure 10 shows the growing trend in gross electricity consumption for Ireland over the period 1990 – 2008 and also includes provisional 2009 data. It illustrates the changing shares of each fuel/energy source. The doubling of gross electricity consumption over the period is striking, as is the growth in gas-generated electricity. As shown in Table 4, the share of gas generation increased from 28% in 1990 to 55% in 2009. These changes provide a context against which the growth in RES-E can be assessed. The fact that renewable energy nearly trebled its share, in the context of a doubling of overall gross electricity consumption, points to the higher absolute growth seen in Figure 10 when compared with percentage growth presented in Figure 11.

Figure 10 Gross Electricity Consumption by Fuel Source



Source: SEAI

Table 4 Gross Electricity Consumption Percentage by Fuel Source

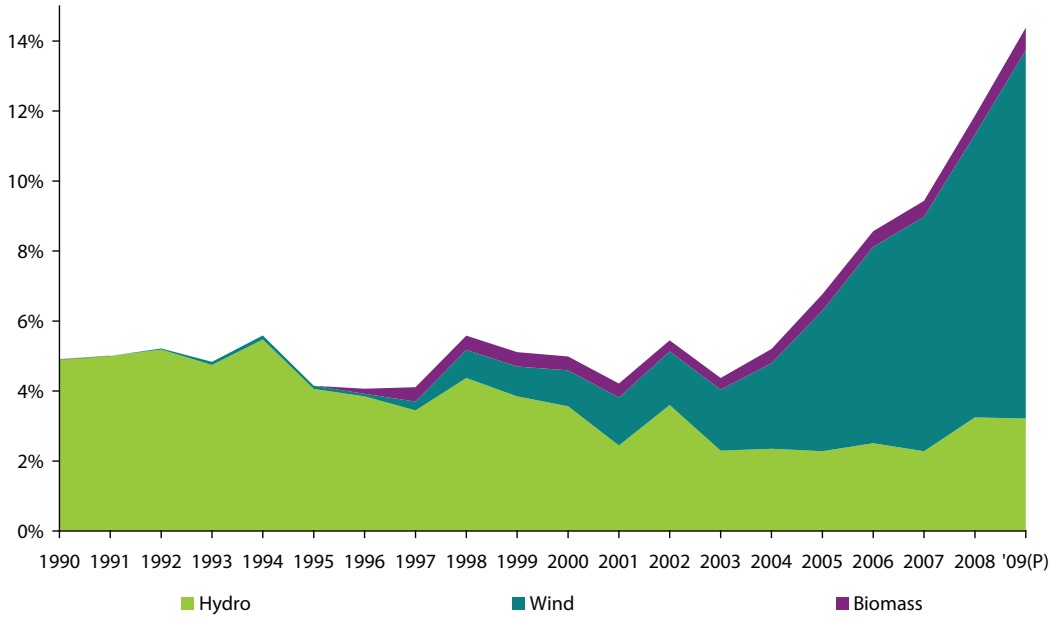
% of Gross	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009(P)
Coal	41.6	39.9	28.7	28.9	26.9	23.8	23.2	23.1	20.4	18.8	17.3	14.5
Peat	15.8	11.5	7.4	9.0	8.2	7.8	5.5	8.9	7.4	7.4	9.1	9.5
Oil	9.9	15.1	19.5	21.3	14.7	9.4	12.0	12.1	9.4	6.8	7.3	3.3
Gas	27.7	29.3	38.9	37.5	42.7	50.1	48.1	41.8	48.1	52.9	53.1	55.6
Renewables	5.0	4.2	5.0	4.3	5.5	4.4	5.2	6.8	8.6	9.4	11.9	14.4
Imports	0.0	-0.1	0.4	-1.0	2.0	4.5	5.9	7.4	6.2	4.6	1.5	2.7

Source: SEAI

While the share from hydro has declined, Figure 11 and Table 5 show how the electricity production contribution from wind energy has grown. There was also a small contribution from waste water biogas (0.06%) from 2003 and from solid biomass CHP (0.05%) since 2004. Wind and hydro energy in 2008 accounted for 8.1% (6.7% in 2007) and 3.2% (2.3% in 2007), respectively, of Ireland's gross electrical consumption while landfill gas was responsible for 0.37% (0.35% in 2007). The remaining 0.23% in 2008 (0.11% in 2007) was from solid biomass.

In calculating the contribution of hydro and wind energy for the purpose of the overall 16% target for renewable energy in Ireland by 2020 in Directive (2009/28/EC) the effects of climatic variation are smoothed through use of a normalisation rule. The normalisation rule is specified in Annex II of the Directive (2009/28/EC).

Figure 11 Renewable Energy (%) Contribution to Gross Electricity Consumption by Source



Source: SEAI and Eirgrid

Table 5 Renewable Electricity as Percentage of Gross Electricity Consumption

	1990	1995	2000	2005	2006	2007	2008	2009(P)
Renewables % of Gross Electricity	4.9	4.1	5.0	6.8	8.6	9.4	11.9	14.4
Hydro	4.9	4.1	3.6	2.3	2.5	2.3	3.3	3.2
Wind	-	0.1	1.0	4.0	5.6	6.7	8.1	10.5
Biomass	-	-	0.4	0.5	0.4	0.5	0.5	0.6

Source: SEAI and Eirgrid

The total electricity generated from renewable energy reached 3,539 GWh in 2008. To achieve the 15% RES-E target by 2010 will require 4,396 GWh according to forecasts in the *Energy Forecasts for Ireland to 2020* (2009 report). This suggests a 24% growth of electricity generation from renewable energy is required over the two year period 2009 – 2010 (or 11.5% average annual growth) in order to deliver the 15% target. Provisional 2009 data shows growth of 14% in 2009 to reach a figure of 4,038 GWh as the total electricity generated from renewable energy. The overall electricity demand reduced in 2009 by 6% so it is likely that the 2010 target will be exceeded.

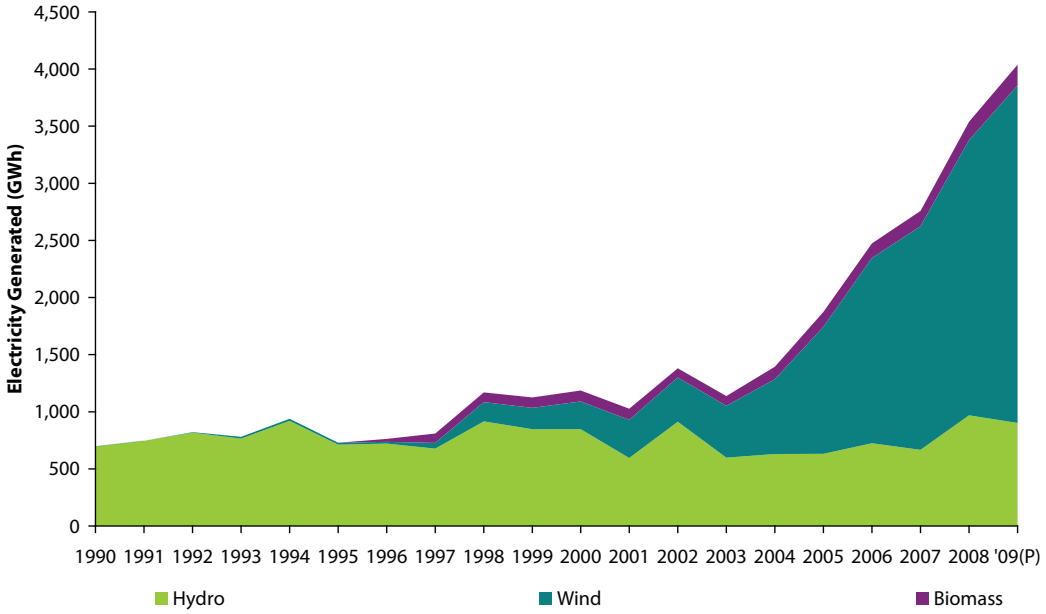
The share of electricity generated from renewable energy sources (RES-E) in 2009 was 14.4% (provisional) which means that Ireland has surpassed the EU interim target of 13.2% RES-E by 2010. Table 5 also suggests that Ireland is firmly on track to meet the Government target of 15% of all electricity generation to be from renewable energy sources by 2010. A significant milestone in 2009 was that wind energy accounted for over 10% of all electricity generation.

Figure 11 and Figure 12 show, in terms of percentage and GWh respectively, the contribution from each renewable energy source to the overall RES-E mix. Biomass here is a collective term comprising electricity generation from solid biomass, landfill gas and biogas, where landfill gas provides the most significant input. The more than doubling of electricity generation from renewable energy that was tabulated in Table 5 is clearly visible in Figure 12, dominated by the growth in wind energy.

The total connected wind capacity as of February 2010 was 1,264 MW[21] and total renewable energy capacity was 1,441 MW[22] at the end of 2009. The peak recorded wind power output[23] was 1,120 MW delivered on Monday 5 April 2010.

21 Connected Wind Farms - 08 February 2010. Available from http://www.eirgrid.com/customers/connectedandcontractedgenerators/
22 Eirgrid's Quarterly Review - Issue 29 Winter 2009 published in March 2010. Available from http://www.eirgrid.com/aboutus/publications/
23 System records are updated on the Eirgrid website, as well as 15 minutes average data on wind power. http://www.eirgrid.com/operations/systemperformancedata/windgeneration

Figure 12 Renewable Energy Contribution (GWh) to Gross Electricity Consumption by Source



Source: SEAI and Eirgrid

In accordance with the amended White Paper target, the new 2020 target for RES-E is 40% of gross electricity consumption. An average annual growth rate of 11.4% is required to meet 12,899 MWh of renewable electricity based on an overall electricity demand of 31,276 MWh in 2020, according to the most recent forecasting exercise by the SEAI Energy Modelling Group in the White Paper Plus scenario.

The total installed electricity generating capacity of wind, hydro and biomass is shown in Table 6. Assuming that the installed capacity targets of 500 MW for ocean energy, 400 MW for biomass and 260 MW for hydro energy by 2020 are met, an installed wind energy capacity of 3,100 MW is required in order to achieve the 2020 RES-E target according to the most recent forecasts i.e. the 40% RES-E target requires 4260 MW_e of installed renewable energy capacity, a threefold increase in current installed capacity.

Table 6 Installed Electricity Generation Capacity – Renewables[24]

MWe	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Wind	-	117	125	138	212	343	495	746	783	1,027	1,264
Hydro	223	236	238	238	240	240	234	234	235	237	239
Biomass	-	12	12	12	12	17	18	25	27	30	33
Total	223	365	375	290	464	600	747	1,005	1,045	1,294	1,441

Source: Eirgrid

4.2 Renewable Transport Energy (RES-T)

Directive (2003/30/EC) on the promotion of the use of biofuels or other renewable fuels for transport aims to replace diesel and petrol for transport purposes in each member state. The government White Paper targets also relates to replacing transport petrol and diesel with biofuels. The subsequent 2020 mandatory target established in the Renewable Energy Directive (2009/28/EC) specifies that in order to calculate the RES-T contribution the total transport energy consists of petrol, diesel, biofuels and electricity consumed in road and rail transport.

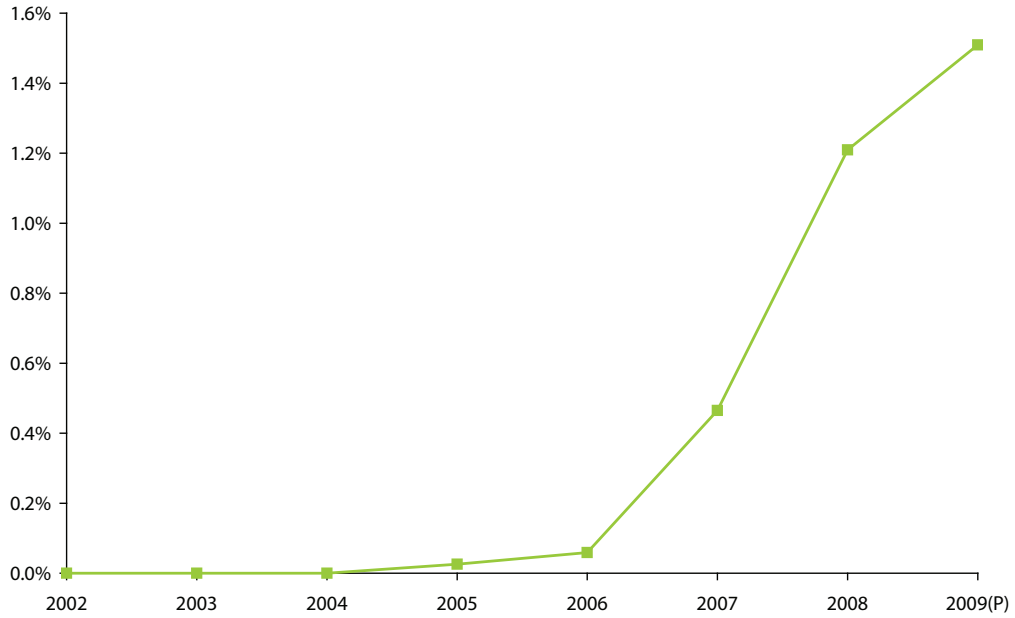
For the Directive (2009/28/EC) target the calculation of the electricity from renewable energy sources consumed by electric road vehicles the contribution will be considered to be 2.5 times the energy content of the input of electricity from renewable

24 Data available from http://www.eirgrid.com. Also see footnotes on page 18

energy sources. Also supported through a weighting factor of 2 are second generation biofuels, and biofuels from waste, i.e. biofuels that diversify the range of feedstocks used to become commercially viable should receive and extra weighting compared to first generation biofuels.

Figure 13 illustrates the dramatic recent growth in renewable energy used for transport (biofuels), albeit from a low base. It shows the ratio of renewable energy used in Ireland as a share of road transport energy, in accordance with the definition in the EU Biofuels Directive (2003/30/EC). It is evident from Figure 13 that the growth coincides with the introduction of tax relief support for biofuels, with slow growth from 2004 to 0.06% in 2006 followed by an increase to 0.5% in 2007 and 1.2% in 2008. The provisional figure for 2009 is 1.5%. Table 7 shows the data behind Figure 13 and in absolute terms, biofuels increased from 1 ktoe in 2005 to 3 ktoe in 2006, 21 ktoe in 2007 and to 56 ktoe in 2008. As mentioned the target for RES-T was 2% by 2008; this was not achieved in 2008 notwithstanding the considerable recent growth.

Figure 13 Renewable Energy as a Proportion of Road Transport Energy



Source: SEAI

Table 7 Biofuels Growth in ktoe and as a Proportion of Road Transport Energy

ktoe	2002	2003	2004	2005	2006	2007	2008	2009(P)
Petrol	1,689	1,687	1,732	1,820	1,884	1,920	1,907	1,744
Diesel	1,956	2,018	2,176	2,329	2,509	2,695	2,673	2,493
Biofuels (ktoe)	0	0	0	1.1	2.6	21.5	55.4	64.0
Petrol plus Diesel	3,645	3,705	3,907	4,149	4,394	4,614	4,581	4,237
Biofuel Penetration	0%	0%	0%	0.03%	0.06%	0.5%	1.2%	1.5%

Source: SEAI

Recent forecasts produced by the SEAI Energy Modelling Group estimate the transport demand in 2020 under the White Paper Plus scenario to be 6,492 ktoe (47% of the projected demand). The target for 2020 is to achieve a 10% contribution of road and rail transport (projected to be 5,790 ktoe) from renewables by a mixture of biofuels and a renewable electricity contribution from electric vehicles. Assuming that the target of 10% electric vehicles share of the vehicle stock is achieved by 2020, this will contribute 1.7[25] percentage points (this includes the contribution from LUAS and DART electric rail systems also) towards the 10% RES-T target in 2020. The remaining 8.3 percentage points or 539 ktoe are anticipated to be delivered by biofuels. Average annual growth rates of 43% per annum for renewable electricity in transport and 21% for biofuels are required in order to meet the RES-T target.

25 Report available from http://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling_Group.

4.3 Renewable Heat (RES-H)

The thermal energy market in Ireland is defined as the energy used for space, process and water heating, cooking etc. It is calculated as the residual energy requirement when energy use from transport and electricity generation are subtracted from the total. Energy use for thermal purposes accounted for 40% of the to gross final energy consumption in 2008. The residential sector accounts for the largest share of final thermal energy use (44% in 2008), followed by industry (33% in 2008), services (18% in 2008) and agriculture (5% in 2008). Oil is the dominant fuel in the thermal energy market accounting for 54% of the primary energy used for thermal purposes in 2008.

Renewable energy contributing to Ireland's thermal energy requirements is dominated by industrial biomass use, in particular the use of waste wood to produce thermal energy in fibre board manufacture, joineries and wood processing plants, and the use of tallow from rendering plants for thermal energy. In addition there is a small contribution included in the industry data from biogas generated by anaerobic digestion of food processing waste products. As shown in Table 8, the increasing activity in these sub-sectors of industry led to industrial biomass use increasing from 63 ktoe in 1990 to 164 ktoe in 2007, but this has dropped back since the 2006 peak to 130 ktoe. While the overall growth between 1990 and 2009 was 106% (average annual growth of 3.9%), there has been an average annual decrease of 5.6% since 2005 as detailed in Table 9. The average annual reduction since 2007 was 7.5% and according to provisional data was 6.4% in 2009. Since 1990 industrial biomass use increased its share from 58% of the total amount of renewable heat in use in all sectors to 66%.

Table 8 Trends in Renewable Thermal Energy (RES-H) by Sector

Renewable Heat (ktoe)	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009(P)
Overall	**108**	**92**	**118**	**130**	**130**	**126**	**152**	**193**	**197**	**200**	**198**	**196**
Industry Total	63	62	100	113	113	108	129	163	164	152	139	130
Wood & wood products	61	59	96	109	109	64	84	109	106	93	88	84
Other industry	2	3	4	4	4	44	45	54	58	59	51	46
Residential	45	30	17	16	16	15	15	25	27	37	44	49
Commercial/Public Services	0	0	0	0	0	2	2	4	6	10	15	16

Source: SEAI

There are two notable trends behind the overall trend in renewable energy use in the residential sector, figures for which are also shown in Table 8. This sector's use of renewable energy is also dominated by solid biomass (wood), but it includes as well recently added geothermal energy and solar thermal energy. Since 1990, there has been a decrease in traditional biomass (firewood) in open fires, in line with the general decline of solid-fuel open fires. As shown in Table 8, biomass usage decreased from 45 ktoe in 1990 to 15 ktoe in 2003, a drop of 66% (or 4.6% per annum reduction). In contrast with this is the more recent increasing trend of 'new biomass' in homes, i.e. the use of wood pellets and wood chips as the penetration of biomass boilers and stoves increases, supported under the Greener Homes Scheme[26], augmented by installations of solar energy and heat pump heating systems. The result of this has been to reverse the overall declining trend in RES-H in households. Between 2004 and 2008 renewable energy use in homes increased from 15 ktoe to 44 ktoe, a threefold increase (or 31% per annum). In 2008, the use of renewable energy for heating in homes represented 22% of total renewable energy thermal energy usage in Ireland. Provisional 2009 data shows growth in the residential sector for RES-H of 11%.

The recent growth in RES-H in the residential sector has also been observed in the services sector, also supported by an SEAI grant scheme, the Renewable Energy Heat Deployment (ReHeat) scheme. Since 2003, there has been a consistent 2 – 3 ktoe of biogas production from anaerobic waste water treatment in the public services sector. This has been augmented from 6 ktoe in 2006 to 10 ktoe in 2007 and 15ktoe in 2008 (50% growth rate in 2008) by solid biomass heating systems in the commercial services sector and to a lesser extent heat pump and solar thermal systems.

Renewable heat is dominated by the contribution of renewable heat from industry. Renewable heat in industry has been decreasing since 2007 and 2009 was the first year that the decrease in industrial renewable heat was not offset by the increases in RES-H in the residential and service sectors.

26 Greener Homes is a capital grant support scheme administered by SEAI for home renewable energy heating systems. See http://www.seai.ie/greenerhomes for details.

According to the White Paper scenario of the energy forecasts published in 2009 by the Energy Modelling Group of SEAI, the thermal energy demand for Ireland will reach 5,160 ktoe in 2010. This suggests that 258 ktoe of renewable energy heat will be required in 2010 compared with 198 ktoe in 2008, representing a 30% growth in the two years 2009 – 2010 or 14% per annum on average, a significant challenge against the context of the recent progress highlighted in Table 9. Provisional 2009 data shows a slight decrease in the amount of renewable heat use indicating a gap to the 2010 RES-H target.

Table 9 Trends in Renewable Thermal Energy (RES-H) by Sector

	Growth %	Average annual growth rates %						Shares %	
Renewable Heat	1990 - 2009	'90 - '09	'90 - '95	'95 - '00	'00 - '05	'05 - '09	2009	1990	2009
Overall	**81.7**	**3.2**	**-3.1**	**5.1**	**10.4**	**0.4**	**-1.2**	**4.7**	**4.0**
Industry Total	105.9	3.9	-0.3	10.1	10.3	-5.6	-6.4	3.3	2.8
Wood & wood products	38.2	1.7	-0.5	10.1	2.6	-6.4	-4.2	2.1	1.8
Other industry	1920.6	17.1	4.6	8.6	65.9	-4.0	-10.3	1.2	1.0
Residential	9.5	0.5	-7.8	-10.4	7.9	18.1	11.2	1.0	0.9
Commercial/Public Services	-	-	-	-	-	41.9	9.1	0.4	0.3

Source: SEAI

Forecasts to 2020 estimate a total thermal consumption of 4,931 ktoe in 2020 requiring 591 ktoe of renewable energy in order to meet the RES-H target of 12% by 2020. This corresponds to an average annual growth rate of 10% over the period 2008 to 2020, against the background of growth at 3% per annum on average between 1990 and 2008 and an overall RES-H growth rate of -1% in 2008 and 2009. This indicates the scale of the challenge in the thermal energy sector to meet the renewables target.

5. Sources of Renewable Energy

This section provides an overview of the various renewable energy sources which are currently reported for the Eurostat and IEA joint renewables and wastes questionnaires. It also provides brief descriptions of other potential renewable energy sources and energy from wastes, as well as recent technological developments. As mentioned in the introduction, energy from wastes currently produced in Ireland (landfill gas, sewage sludge gas, wood wastes, tallow, and meat and bone meal) is classified as renewable sources of energy.

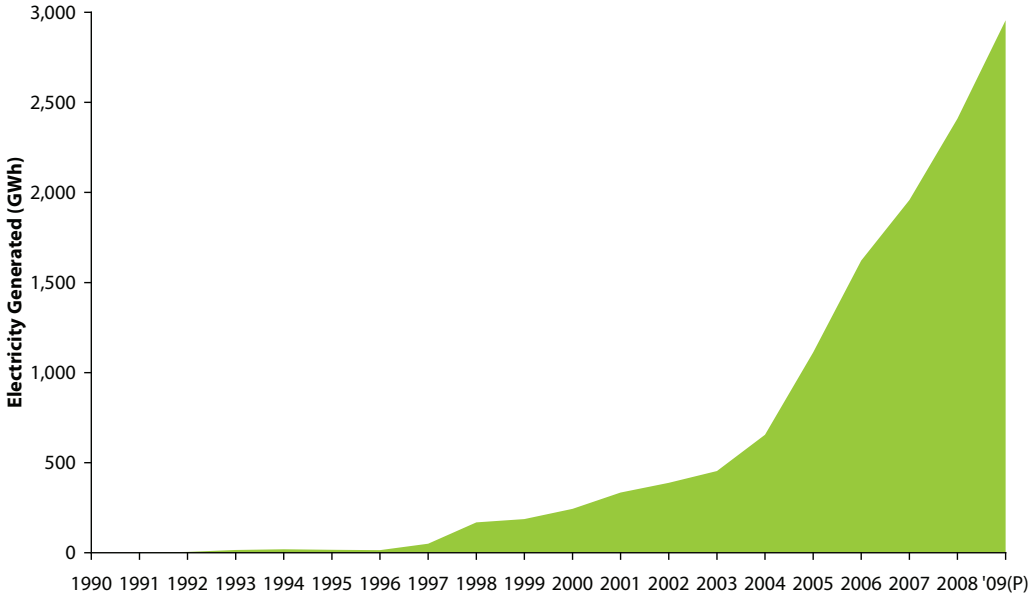
Increasing the deployment of renewables is part of the strategy to improve energy security for Ireland. In 2008 the country had an energy import dependency of 89%. Of the indigenous energy production in 2008 renewable energy was responsible for 35%.

In 2008 renewable energy consisted of 3.6% of the total primary energy supply and 3.9% of gross final consumption. As renewables are starting from such a low base these shares seem small. However when the growth rates of individual fuels are examined an interesting picture emerges.

5.1 Wind – On-shore and Off-shore

Figure 14 and Table 10 show the electricity generated from wind energy and illustrate the rapid rise in electrical output since 1997 when the first of the wind farms supported by the Alternative Energy Requirement (AER) programme came online. Total electrical output from wind in 2009 was 2,955 gigawatt hours (GWh) representing an increase of 23% on 2008, the same increase as between 2007 and 2008. Wind was responsible for 10.5% of gross electrical consumption in 2009 (8.1% in 2008).

Figure 14 Electricity Generated by Wind



Source: Eirgrid

Table 10 Renewable Electricity Production – Wind

	1990	1995	2000	2005	2006	2007	2008	2009
Wind (GWh)	0	16	244	1,112	1,622	1,958	2,410	2,955

Source: Eirgrid[27]

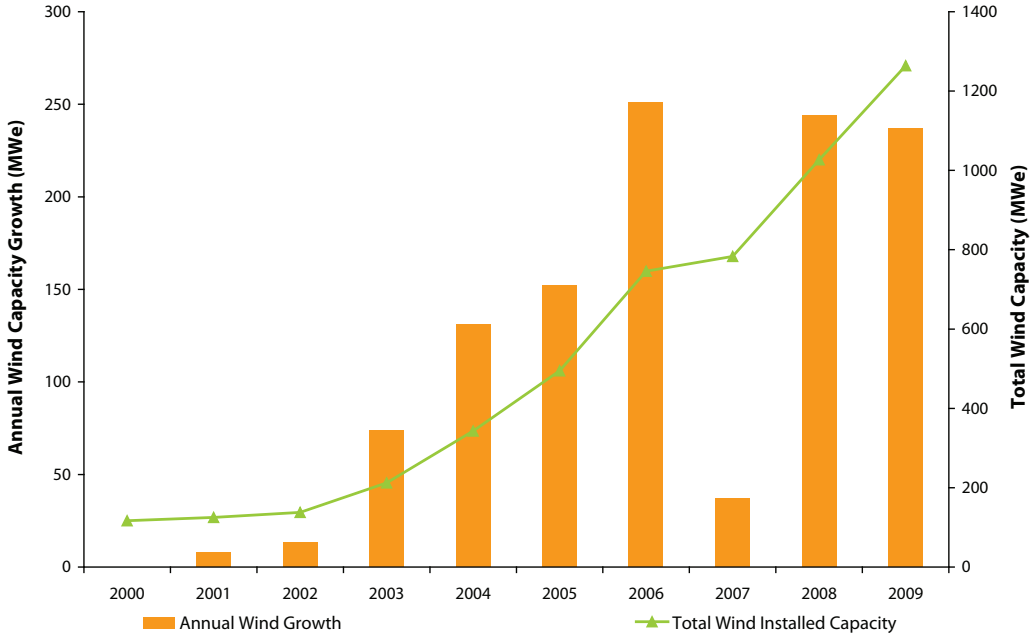
Figure 15 traces the evolution in installed wind capacity from 2000 to 2009 (the first wind farms came on line in 1992). It shows the annual incremental capacity added and the trend in total wind capacity on the Irish transmission and distribution networks. The surge in wind farm construction activity in the period 2003 – 2006 is very clear and resulted in Ireland (the All-

27 Wind power is published as 15 minute average data on http://www.eirgrid.com/operations/systemperformancedata/windgeneration

Island network) reaching the highest level of wind power penetration in the world[28]. While total installed wind capacity in Ireland is low compared with Germany, Spain and Denmark, wind power penetration is higher in the Irish system than in either the British, UCTE or NORDEL synchronous power systems.

While there was a dramatic slowdown in wind farm development in 2007, the rate of development increased again in 2008 and 2009. The total installed capacity reached 1,264 MW by January 2010. In addition to the 1,264 MW currently installed there are a number of wind farms with grid connection contracts and target connection dates under the Gate 3 connection process. There is a further 155 MW contracted and a further 3,900 MW is proposed within the Gate 3 planning process. Wind farms with an additional combined capacity of 219 MW for onshore wind and 52 MW offshore wind have target connection dates during 2010.

Figure 15 Installed Wind Generating Capacity 2000 - 2009



Source: Eirgrid

The existing wind data is not currently split between on-shore and off-shore wind energy. This is because there is currently only one off-shore wind farm in Ireland. This is the Arklow Bank with a capacity of 25.2 MW. A renewable energy feed-in tarriff (REFIT) of 14 cents per kWh is available from the Irish government since February 2008. Within the first 8 years of the Gate 3 ITC programme (2010 - 2017) 601.5 MW of offshore wind is due to be connected to the grid. The new connections are on the east coast of Ireland at Carrickmines (364 MW) and Oriel (237.5 MW). There are no statistics currently available on the energy produced by small turbines for auto production in industry and domestic installations. A domestic micro-generation rate is available from ESB Customer Services as mentioned in section A2.7 on page 38.

5.2 Hydro Energy

There are 14 hydroelectric[29] generators connected to the transmissions system (maximum export capacity {MEC} of > 4 MW). The total hydro connected to the transmission system is 212 MW. This is 2.8% of the total connected generation capacity. There are a further 52 micro (< 1 MW) hydroelectric generators connected to the distribution system with an installed capacity of 25.1 MW. Further growth in large scale hydro projects is not currently planned. However there are 6 micro generation projects of 11 MW capacity contracted for distribution system connections.

28 Measured as the ratio between installed wind generation capacity and overall generating capacity for a synchronous power system. For more detail see Ó Gallachóir B. P., Gardner P., Snodin H. & McKeogh E. J. *Wind Energy Systems Security - The Grid Connection Moratorium in Ireland*. International Journal of Energy Technology and Policy (IJETP) **5** 633 - 647

29 Eirgrid *TSO and DSO Non-Wind Generators - Connected (05 March 2010).* Available from http://www.eirgrid.com/customers/connectedandcontractedgenerators/

5.2.1 Pumped Hydro Storage

There is currently only one pumped hydro[30] station in Ireland. The station comprises four 73 MW generators to give a total capacity of 292 MW. There is a lot of research into pumped hydro storage in Ireland[31] as a method of storage for wind energy. There are a further 5 pumped hydro generators in the planning process with a total capacity of 415 MW.

5.3 Ocean Energy – Tidal & Wave

5.3.1 Tidal Energy

The tidal accessible resource in Ireland is limited by commercial constraints (including development costs and market reward), policy targets and programmes in place. It is estimated at 0.92 TWh[32] per annum . To put this figure in context this equates to 3.4% of the total electricity demand for 2008.

An Irish company (Open Hydro) was the first company to install a tidal energy device in the European Marine Energy Centre (EMEC) off the Scottish coast in 2006. The world's first commercial tidal energy device was connected to the grid in Northern Ireland in April 2008. The device, 'Sea-Gen', a 1.2MW tidal current energy converter device developed by a UK company (Marine Current Turbines), is located in Strangford Lough.

5.3.2 Wave Energy

It is estimated that an accessible wave energy resource of 21 TWh per annum[33] exists within the total limit of Irish waters. This equates to just over two thirds of the total electricity demand in 2008. The government has a target of 500 MW of installed wave energy capacity by 2020 and an ambition for Ireland to be a world leader in the development of wave energy. Since 2008 a REFIT payment of 22 cents per kWh is available for electricity from wave energy. The government also announced the development of a full scale test site for wave energy devices off the west coast of Ireland, at Belmullet, Co. Mayo, in 2008. In February 2010 a weather buoy was deployed off the coast of North Mayo to monitor wave and weather conditions.

There are currently a number of wave energy devices being tested in the Galway Bay test site for quarter scale devices. A number of devices designed by Irish companies are being tested in the Galway Bay site and at other locations around the world. While there are plenty of different wave energy device prototypes in development, a commercial wave energy device does not exist yet.

5.4 Solar

5.4.1 Photovoltaic

Globally 90% of the world's population live within 3,000 km of a desert[34] so the envisaged future for photovoltaic (PV) energy in power plants, is that supergrids will link photovoltaic installations to the main population centres. There are not many photovoltaic installations in Ireland, as it is an expensive way of producing electricity here relative to other renewable energy sources. There were 15 micro-generation sites connected at the end of November 2009, with a total installed capacity of 33.9 kW. Photovoltaic energy is not supported under the Government REFIT scheme or the Greener Homes Scheme administered by SEAI but there is the availability of the domestic micro-generation rate from ESB Customer Services as mentioned in section A2.7 on page 38. While there are also some existing standalone commercial and domestic installations, statistics are not available for these installations.

5.4.2 Solar - Thermal

The annual solar radiation in Ireland is 1,000 kWh/m^2. The amount of solar energy used in Ireland is estimated from applications to the SEAI-administered Greener Homes scheme and the Renewable Energy Heat Deployment (ReHeat)[35] scheme for the commercial sector. Since 2008 all new domestic buildings are required to install renewable energy sources to provide at least 10 kWh/yr so any solar installations contributing to meeting this requirement of the 2008 domestic building regulations are also included. In 2008, 0.1% of the total residential sector energy requirements were met by solar thermal energy.

30 Eirgrid *TSO and DSO Non-Wind Generators - Connected (05 March 2010)*. Available from http://www.eirgrid.com
31 For example the Spirit of Ireland project. For more information see http://www.spiritofireland.org/
32 SEAI Publication, *Tidal and Current Energy Resource in Ireland* available from http://www.seai.ie/Renewables/Ocean_Energy/Irelands_Tidal_Energy_Resource/
33 http://www.seai.ie/Renewables/Ocean_Energy/Ireland's_Wave_Energy_Resource
34 http://www.desertec.org/fileadmin/downloads/desertec-foundation_redpaper_3rd-edition_english.pdf
35 Renewable Heat (ReHeat) Deployment Programme, administered by SEAI, provides assistance for the deployment of renewable heating systems in industrial, commercial, public & community premises. http://www.seai.ie/Grants/Renewable_Heat_Deployment_Programme/

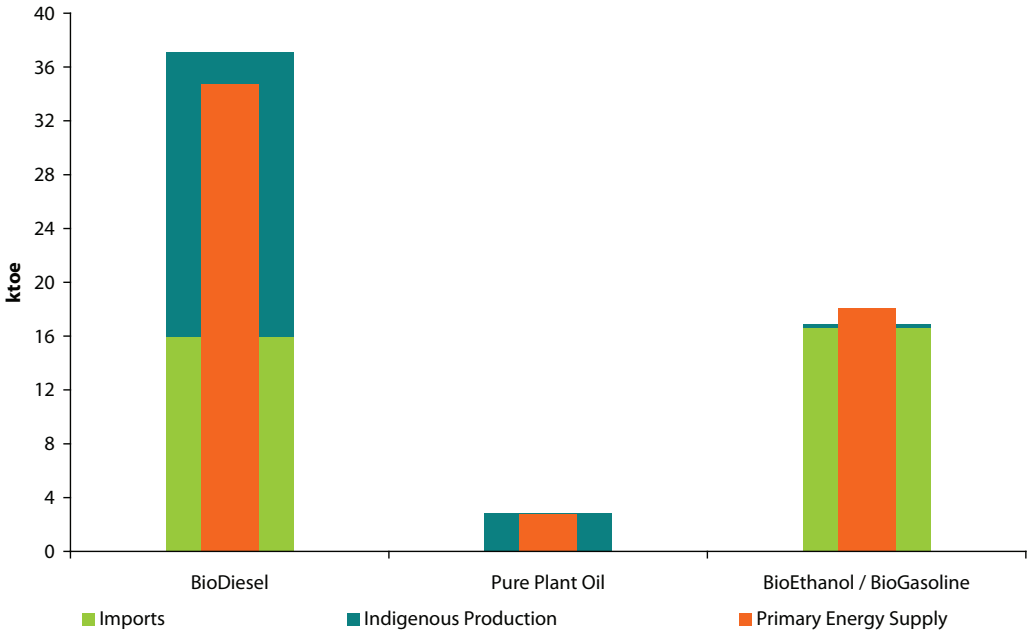
5.5 Biofuels

Figure 16 shows the contribution of different biofuels to Ireland's transport energy supply in 2008. The graph distinguishes between the amount of biofuels produced and imported (the thicker green bars) and the amount used (the thinner orange bar) in 2008. The amount produced and imported need not necessarily sum to the amount used due to stock changes.

The dominant fuel is biodiesel, representing 63% of biofuel usage in 2008, followed by bioethanol (32%) and finally pure plant oil (5%). It is also apparent from Figure 16 that during 2008, there were more biofuels imported than produced indigenously. Indigenous production accounted for 43% of biofuels used or stockpiled in 2008, while imports accounted for 57%.

The proportion of indigenous production compared to imports varies according to the biofuel. In bioethanol, imports represent almost seventy times the amount produced in Ireland. There was 25% more biodiesel produced indigenously than was imported in 2008 (i.e. 57% produced indigenously and 43% imported) and pure plant oil used for transport purposes here was all produced in Ireland. The sources of biofuels are likely to come under increased scrutiny with the focus on the sustainability criteria for biofuels in the Directive 2009/28/EC, discussed in section 3.1.

Figure 16 Biofuels Production, Imports and Usage (2008)



Source: SEAI

5.6 Combustible Renewables

5.6.1 Solid Biomass

Solid biomass covers organic , non-fossil material of biological origin which may be used as fuel for heat production or electricity generation. It is primarily wood, wood wastes (firewood, wood chips, barks, sawdust, shavings, chips, black liquor[36] etc.) and other solid wastes (straw, oat hulls, nut shells, tallow, meat and bone meal etc.). Only a small amount of biomass is currently used in the CHP plants (3.8% in 2008). Most of the solid biomass is used for thermal energy in the industrial sector (78% in 2008) with small portions in both the residential (13%) and commercial sectors (6%). In the Government's Energy White Paper there is a target to have 30% biomass co-firing with peat in the three stated-owned peat-generation stations by 2015.

5.6.2 Biogas

Biogas consists of landfill gas, sewage sludge gas and other gas produced by anaerobic digestion. Landfill gas is reported separately to biogas in the Irish energy balance. In 2008 the biogas figure in the Irish energy balance consisted of an estimate of energy generated in waste water treatment plants and other biogas installations in industry.

36 This is a recycled by-product formed during the pulping of wood in the paper-making industry.

5.6.2.1 Sewage Sludge Gas

Sewage sludge gas is produced by county councils and used for the auto production of electricity in sewage treatment facilities.

5.6.2.2 Other Biogas

Biogas produced from the anaerobic digestion of animal slurries, wastes in abattoirs, breweries and other agri-food industries. Anaerobic digestion is a cost effective method of producing heat/electricity and reducing harmful wastes.

5.6.3 Landfill Gas

Landfill gas (LFG) is regarded as a waste energy source as opposed to a renewable or sustainable energy source. Landfill gas in Ireland is only used for electricity generation. There are 15 landfill gas generators connected to the distribution grid with a MEC of 35.8 MW., with a further 2.6 MW contracted and 16.2 MW requesting connection outside of the Gate 3 process. Landfill gas is unlikely to have significant growth as an energy source due to limitations on how much waste can be sent to landfills.

5.7 Wastes

5.7.1 Industrial Waste (non-renewable)

Renewable industrial wastes are reported in the categories of solid biomass, biogas and/or liquid biofuels, as appropriate. Industrial waste which is non-renewable should be reported on a net calorific value basis. Non-renewable industrial waste is not currently used as a source of energy in Ireland.

5.7.2 Municipal Waste

There is currently one municipal waste-to-energy plant under construction in Ireland. The facility is based in Duleek, Co. Meath and is due to become operational in 2011, managing 200,000 tonnes of residual waste per annum and generating 15 MW of electricity. The quantities of fuels used are reported on a net calorific value basis. There are currently plans for other waste-to-energy plants in Ringaskiddy, Co. Cork and in Poolbeg, Dublin.

5.7.2.1 Renewable Municipal Waste

The biodegradable part of municipal waste produced by households, industry, hospitals and the tertiary sector is considered to be 'renewable biomass'.[37] The quantities of fuels used are reported on a net calorific value basis. The renewable municipal waste currently used in Ireland as an energy source is classified under landfill gas.

5.7.2.2 Municipal Waste (non-renewable)

This covers the non-biodegradable part of municipal waste produced by households, industry, hospitals and the tertiary sector that is incinerated at specific locations. The quantities of fuels used are reported on a net calorific value basis. Non-renewable municipal waste is not currently used as a source of energy in Ireland.

5.8 Geothermal Energy

The geothermal energy statistics in Ireland currently cover installations which were grant aided by SEAI plus an estimate for additional units. A coefficient of performance of 3.5 is estimated for all installations. This means that for every 1 unit of electricity used by geothermal heat pumps 3.5 units of heat energy are produced. The heat produced is the figure used for geothermal energy in the balance. Geothermal installations include horizontal and vertical ground source heat pumps.

While existing geothermal energy installations involve individual sites , an investigation is being carried out into a geothermal district heating system using a deep geothermal aquifer in the Dublin basin.[38]

37 Article 2 (e) of Directive (2009/28/EC). See footnote on page 9.
38 More information available from GT Energy. http://www.gtenergy.net

6. CO_2 Displacement

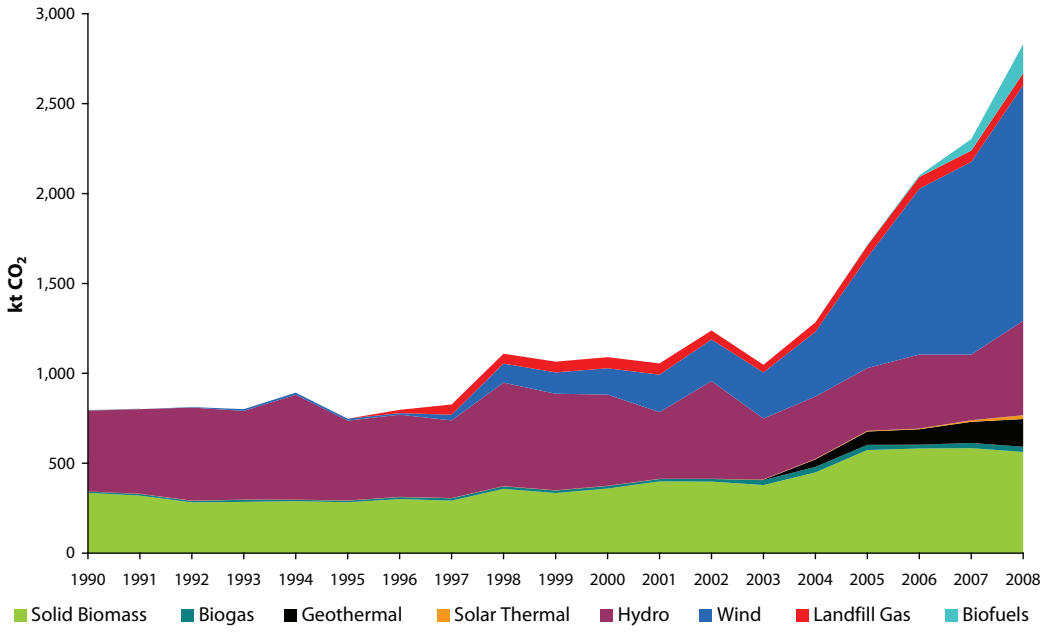
The primary energy equivalent (PEE) of renewable energy sources is described in section 2.4. The methodology used to calculate the PEE is included in Appendix 1. One of the benefits of determining the PEE associated with non-combustible renewables is that it can be used to calculate the amount of CO_2 avoided through the use of renewable energy. The caveats associated with the results for primary energy equivalent apply equally to the calculated CO_2 avoided.

Figure 17 shows the trend in avoided CO_2 emissions from renewable energy for the period 1990 – 2008. It is assumed the electricity from renewables (wind, hydro, landfill gas and the electricity portion of waste water biogas) avoids the amount of CO_2 produced by the weighted average electricity production from the same marginal plant considered in Appendix 1 – i.e. oil and single cycle gas plant.

It is further assumed that the thermal energy from renewable energy (solid biomass, biogas, geothermal and solar and the thermal portion of waste water biogas) displaces thermal energy from oil-fired boilers. The CO_2 avoided from thermal renewable energy is equated with the CO_2 emissions that would have arisen from this oil consumption.

The avoided CO_2 emissions associated with biofuels usage in transport assumes 100% displacement of emissions from conventional fuels. The emissions from biofuels production are accounted for in this analysis in accordance with the UNFCCC reporting guidelines[39]. Thus the CO_2 avoided from bioethanol in transport is equated with CO_2 emissions that would have arisen from petrol consumption and CO_2 avoided from biodiesel and pure plant oil is equated with diesel consumption.

Figure 17 Avoided CO_2 from Renewable Energy 1990 to 2008



Source: SEAI

Based on this methodology the estimated amount of CO_2 avoided from renewable energy increased by 257% (7.3% per annum on average) over the period 1990 to 2008, reaching 2,830 kt CO2 in 2008, illustrated in Figure 17. The emissions avoided from wind were most significant in 2008, 1309 kt CO_2 (46%), followed by solid biomass 562 kt CO_2 and hydro 526 kt CO_2.

39 Emissions from fossil fuels used in the production of biofuels in Ireland are captured separately in the transformation section of the energy balance.

7. The Future of Renewables in Ireland

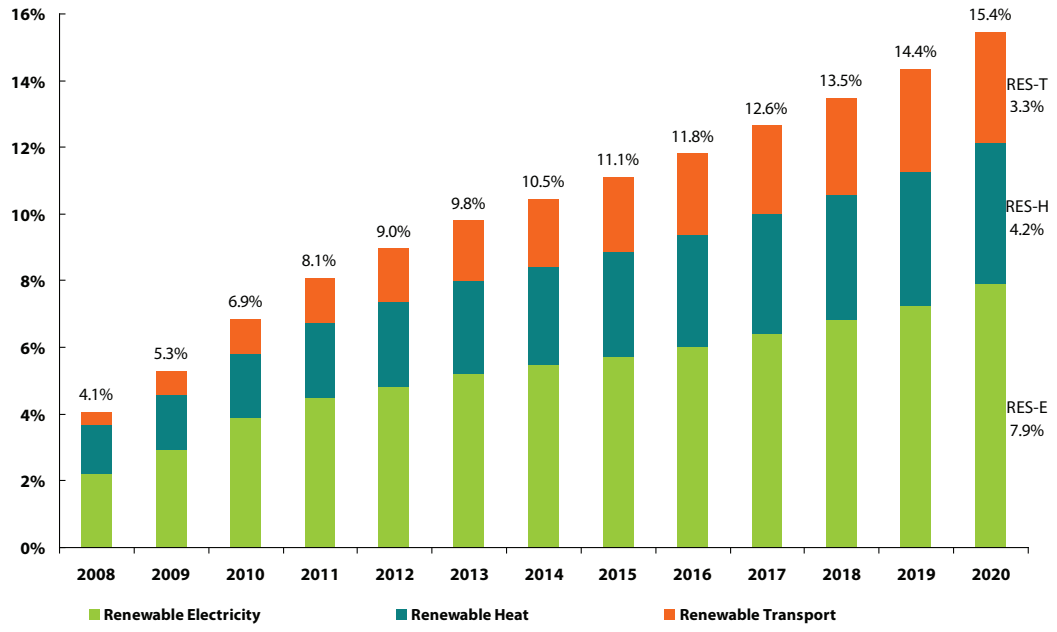
7.1 Energy Forecast to 2020

In order to inform policy formulation, the SEAI Energy Modelling Group (EMG), in conjunction with ESRI, produced[40] forecasts which examine energy usage in 2020. Three sets of forecast scenarios were prepared. The first, the Baseline scenario, is not anticipated to represent a realistic outcome, but is useful in presenting a base case against which other forecasts may be compared. The second, the White Paper Plus scenario, builds on the Baseline forecast, with additional assumptions introduced to incorporate the targets contained in the Energy White Paper, and the National Energy Efficiency Action Plan (NEEAP). The third, the Exploratory scenario, builds on the White Paper Plus scenario but assumes a greater level of renewable electricity generation.

The forecasts for the individual RES-E, RES-T and RES-H targets are discussed in section 4 and are summarised here in the context of meeting Ireland's overall renewable energy target. Figure 18 presents the forecast of the renewable energy contribution to TFC (according to the definitions in the proposed Directive) for the White Paper scenario indicating separately the contribution to electricity (RES-E), transport (RES-T) and thermal energy (RES-H). The RES contribution in 2020 achieves 15.4% in the White Paper scenario.

It is important to note that the energy efficiency savings are also contained within these forecasts. Since the renewable energy targets are expressed as percentages of energy consumption, any decrease in energy savings, or increase in energy demand due to other factors, will increase the amount of renewable energy production required to meet the renewable energy targets.

Figure 18 Renewable Energy Contribution to TFC (White Paper Scenario)



Source: SEAI

The forecasts also predict a 1% increase in non-emissions trading CO_2 emissions compared to 2005 levels, which is significant in the context of the requirement under EU Decision 406/2009/EC to achieve a 20% reduction on 2005 levels by 2020.

40 These forecasts were originally published in *Energy Forecasts for Ireland to 2020.* Available from http://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling _Group

7.2 National Renewable Energy Action Plan (NREAP)

To ensure that national mandatory targets are achieved as part of the Renewable Energy Directive (2009/28/EC) each member state must submit a National Renewable Energy Action Plan (NREAP) by June 30th 2010. As part of Ireland's NREAP the least-cost trajectory toward achieving overall renewable energy targets which will be achieved from indigenous resources needs to be identified. If Ireland is unable to meet the target with indigenous renewable energy sources, there are flexible mechanisms outlined in the Directive which could assist in meeting both the EU and Government targets. Recent analysis points to one option for Ireland to meet the RES-T target using indigenous sources.[41]

The flexible mechanisms outlined in the Renewable Energy Directive (2009/28/EC) are co-operating mechanisms and short term statistical transfers. The "co-operating mechanisms" enable trading of compliance with other member states and also enable purchase from outside the EU with matching physical import. The Directive also outlines "short-term statistical transfers", where Member States may agree on and may make arrangements for the statistical transfer of a specified amount of energy from renewable sources from one Member State to another Member State.

41 Smyth B.M., Ó Gallachóir B. P., Korres N. E. and Murphy J. D. (2010). *Can we meet targets for biofuels and renewable energy in transport given the constraints imposed by policy in agriculture and energy?* Journal of Cleaner Production (In Press).

Glossary of Terms

Bio-diesel: Includes bio-diesel, biodimethylether (DME), Fischer-Tropsh diesel, cold-pressed bio-oil and all other liquid bio-fuels which are added to or blended with or used straight as transport diesel.

Bio-fuels: Liquid fuels derived from biomass crops or by-products that are suitable for use in vehicle engines or heating systems. They can be considered as potential replacements or extenders for mineral fuels such as diesel or petrol. They can be sub-divided into a number of categories, the principal two being:

- Vegetable oils / animal fats which can be used in unprocessed form or converted to biodiesel.
- Bio-ethanol produced from the fermentation of organic materials such as sugar beet, cereals, etc.

Bio-gas: A gas composed principally of methane and carbon dioxide produced by anaerobic digestion of biomass, comprising: Sewage sludge gas, produced from the anaerobic fermentation of sewage sludge and Other biogas, such as biogas produced from the anaerobic fermentation of animal slurries and of wastes in abattoirs, breweries and other agro-food industries.

Bio-gasoline: Includes bio-ethanol, bio-methanol, bio-ethyl-ter-butyl ether (bioETBE) and bio-methyl-tertio-butyl-ether (bioMTBE).

Carbon Dioxide (CO_2): A compound of carbon and oxygen formed when carbon is burned. Carbon dioxide is one of the main greenhouse gases. Units used in this report are t CO_2 (tonnes of CO_2), kt CO_2 (kilo-tonnes of CO_2 {10^3 tonnes}) and Mt CO_2(mega-tonnes of CO_2 {10^6 tonnes}).

Combined Heat & Power Plants: Combined heat and power (CHP) refers to plants which are designed to produce both heat and electricity. CHP plants may be autoproducer (generating for own use only) or third-party owned selling electricity and heat on-site as well as exporting electricity to the grid.

Geothermal energy: Geothermal energy refers to heat energy stored in the ground. Heat is supplied to the ground from two sources namely the hot core of the planet and the sun. It can be classified as either 'deep' or 'shallow' depending on the depths involved.

Gross Calorific and Net Calorific Value (GCV & NCV): The gross calorific value (GCV) gives the maximum theoretical heat release during combustion, including the heat of condensation of the water vapour produced during combustion. This water is produced by the combustion of the hydrogen in the fuel with oxygen to give H_2O (water). The net calorific value (NCV) excludes this heat of condensation because it cannot be recovered in conventional boilers. For natural gas, the difference between GCV and NCV is about 10%, for oil it is approximately 5%.

Gross Final Consumption (GFC): The Renewable Energy Directive (2008/28/EC) defines gross final consumption of energy as the energy commodities delivered for energy purposes to manufacturing industry, transport, households, services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution.

Heat Pump: A heat pump is a device that moves heat from one location (the source) to another (the sink). Heat pumps are used for space heating and cooling, as well as water heating. Geothermal heat pumps operate on the fact that the earth beneath the surface remains at a constant temperature throughout the year, and that the ground acts as a heat source in winter and a heat sink in summer. They can be used in both residential and commercial or institutional buildings. Other heat pump types are available such as air and water source. These operate on the same principle indoors but the method of collecting heat is different for each type.

Gross Electrical Consumption: Gross electricity production is measured at the terminals of all alternator sets in a station; it therefore includes the energy taken by station auxiliaries and losses in transformers that are considered integral parts of the station. The difference between gross and net production is the amount of own use of electricity in the generation plants.

Hydro-Power: Potential and kinetic energy of water converted into electricity in hydroelectric plants. Pumped storage is treated separately in the national energy balance. The renewable energy Directive (2009/28/EC) states that electricity produced

in pumped storage units from water that has previously been pumped uphill should not be considered to be electricity produced from renewable energy sources.

Kilowatt Hour (kWh): The conventional unit of energy whereby electricity is measured and charged for commercially. Related units are megawatt hour (MWh) and gigawatt hour (GWh) which are one thousand and one million kWhs respectively.

Landfill Gas (LFG): A gas composed principally of methane and carbon dioxide produced by anaerobic digestion landfill wastes.

Microgeneration: A microgenerator might use any one of the following technologies to generate electricity: Wind turbine, Photovoltaic panels (also known as solar electric panels), Micro-hydro (scaled down version of hydro-electricity station), Micro-CHP (fuelled by bio or fossil fuels). In Ireland microgeneration is classified by ESB Networks as grid-connected electricity generation up to a maximum rating of 11 kW when connected to the three-phase grid (400 V). The vast majority of domestic and agricultural customers are connected at single phase (230V) and for these customers to be classified as microgenerators the maximum rating permitted is 5.75 kW. These ratings are in line with Irish conditions prescribed in European standard EN50438.

Photovoltaic Energy: Energy from solar electric panels. Solar radiation is exploited for electricity generation by photovoltaic cells which convert the solar radiation into DC current.

RES-E: Renewable energy sources in electricity.

RES-H : Renewable energy sources of heat/thermal energy.

RES-T: Renewable energy sources used for transportation.

Solid Biomass: Covers organic, non-fossil material of biological origin which may be used as fuel for heat production or electricity generation. It comprises: (a) Charcoal, covering the solid residue of the destructive distillation and pyrolysis of wood and other vegetal material and (b) Wood, wood wastes and other solid wastes, covering purpose-grown energy crops (poplar, willow etc.), a multitude of woody materials generated by an industrial process (wood/paper industry in particular) or provided directly by forestry and agriculture (firewood, wood chips, bark, sawdust, shavings, chips, black liquor etc.) as well as (c) wastes such as tallow, straw, rice husks, nut shells, poultry litter, crushed grape dregs etc. Combustion is the preferred technology for these solid wastes. The quantity of fuel used is reported on a net calorific value basis.

Tonne of Oil Equivalent (toe): This is a conventional standardized unit of energy and is defined on the basis of a tonne of oil having a net calorific value of 41686 kJ/kg.

Total Final Consumption (TFC): This is the energy used by the final consuming sectors of industry, transport, residential, agriculture and tertiary. It excludes the energy sector such as electricity generation and oil refining etc.

Total Primary Energy Requirement (TPER): This is the total requirement for all uses of energy, including energy used to transform one energy form to another (eg burning fossil fuel to generate electricity) and energy used by the final consumer.

Wind Energy: Kinetic energy of wind exploited for electricity generation in wind turbines.

References

Dept. of Agriculture & Food (2007), BioEnergy Scheme for Willow and Miscanthus, http://www.agriculture.gov.ie/farmerschemespayments/otherfarmersschemes/bioenergyscheme/

Dept. of Agriculture & Food (2007), Wood Biomass Harvesting Machinery Scheme, http://www.agriculture.gov.ie/contentarchive/forestry/woodbiomassharvestingmachineryscheme/

Dept. of Communications, Energy & Natural Resources (2007), Bioenergy Action Plan, http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Report+for+website.htm.

Dept. of Communications, Energy & Natural Resources (2007), *Energy White Paper 2007 - Delivering a Sustainable Energy Future for Ireland*, http://www.dcenr.gov.ie/Energy/Energy+Planning+Division/Energy+White+Paper.htm.

Dept. of Communications, Energy & Natural Resources (2008), *Public Consultation on the Biofuels Obligation Scheme - September 2008*. http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Biofuels+Obligation+Scheme.htm

Dept. of Communications, Energy & Natural Resources (2008), *Minister for Communications, Energy and Natural Resources on 29th September 2008*. http://www.dcenr.gov.ie/Press+Releases/2008/Minister+Ryan+proposes+new+target+for+biofuels+in+Ireland.htm

Dept. of Communications, Energy & Natural Resources (2008), *Renewable Energy Feed-in Tarrifs (REFIT Tarrifs)*, http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Sustainable+and+Renewable+Energy+Division.htm

Dept. of Communications, Energy & Natural Resources (2008), *Charles Parsons Award Advert*, http://www.dcenr.gov.ie/Energy/Parsons_Awards_Advert.htm

Dept. of Communications, Energy & Natural Resources (2008), *Irish Energy Research Council's Energy Research Strategy*, http://www.dcenr.gov.ie/Energy/Office+of+the+Chief+Technical+Advisor/Irish+Energy+Research+Council.htm

Dept. of the Environment (2008), *Carbon Budget 2009*, http://www.environ.ie

Dept. of the Environment (2007), *Carbon Budget 2008*, http://www.environ.ie

Dept. of the Environment (2007), *National Climate Change Strategy 2007-2012*, http://www.environ.ie/en/Publications/Environment/Atmosphere/

Dept. of the Environment (2004), *Waste Management — Taking Stock and Moving Forward*. http://www.environ.ie/en/Environment/Waste/

Desertec Foundation (2008), *Redpaper — An overview of the desertec concept*, http://www.desertec.org/fileadmin/downloads/desertec-foundation_redpaper_3rd-edition_english.pdf

Eirgrid (2010), *Quarterly Review - Issue 29 Winter 2009*, http://www.eirgrid.com

Eirgrid (2010), *Connected Wind Farms 8th February 2010*, http://www.eirgrid.com

Eirgrid (2010), *TSO and DSO Non-Wind Generators - Connected,* http://www.eirgrid.com/customers/connectedandcontractedgenerators/

Eirgrid (2010), *System Records*, http://www.eirgrid.com/operations/systemperformancedata/systemrecords/

Eirgrid (2010), *Quarterly Review: Issue 29 - Winter 2009*, http://www.eirgrid.com/aboutus/publications/

Eirgrid (Sept. 2008), Winter Outlook 2008 – 2009, http://www.eirgrid.com/EirgridPortal/uploads/Announcements/Winter%20Outlook%20150808%20Final.pdf.

Eirgrid (2009), *Grid 25 - A Strategy for the Development of Ireland's Electricity Grid for a Sustainable and Competitive Future,* http://www.eirgrid.com

Environmental Protection Agency (2007), *National Allocation Plan 2008 - 2012*. Available from http://www.epa.ie/downloads/pubs/air/etu/NAP2%20_Final%20_Allocation%20_Decision_040320082.pdf

European Commission (January 2008), *Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources*, http://ec.europa.eu/energy/climate_actions/doc/2008_res_directive_en.pdf.

European Commission (2008), *The EU Climate and Energy Package*, http://ec.europa.eu/environment/climat/climate_action.htm

European Commission (2008), *Submission from Ireland under Article 4(3) of Directive 2009/28/EC on the promotion of use of energy from renewable sources*, http://ec.europa.eu/energy/renewables/transparency_platform/doc/ireland_forecast_english.pdf

International Energy Agency (2007), *Energy Balances of OECD Countries 2004 – 2005*. http://www.iea.org.

Irish Government (2007), *Statutory Instrument no. 83 of 2007*, http://www.irishstatutebook.ie/home.html

Irish Government (2007), *Statutory Instrument no. 235 of 2008,* http://www.irishstatutebook.ie/home.html

Office of the Revenue Commissioners (2008), *Relief for Investment in Renewable Energy Generation,* http://www.revenue.ie/en/business/incentives/renewable-energy-generation-taxrelief.html

Office of the Revenue Commissioners (2008), *Business Expansion Scheme: Relief for Investments in Corporate Trades*, http://www.revenue.ie/en/business/reliefs-incentives.html

Kartha S., Lazarus M. and Bosi M, (2004), *Baseline recommendations for greenhouse gas mitigation projects in the electric power sector*. Energy Policy 32, 545-566.

Murphy JD, Power N (2008), *How can we improve the energy balance of ethanol production from wheat?*, Fuel, Volume 87, pp 1799 – 1806.

Ó Gallachóir B. P., Gardner P., Snodin H. & McKeogh E. J. (2007), *Wind Energy and System Security - The Grid Connection Moratorium in Ireland*. International Journal of Energy Technology and Policy (IJETP) 5 633 – 647

Ó Gallachóir B. P., O'Leary F., Bazilian M., Howley M. & McKeogh E. J. (2007), *Comparing Primary Energy Attributed to Renewable Energy with Primary Energy Equivalent to Determine Carbon Abatement in a National Context.* Journal of Environmental Science and Health Part A: Toxic /Hazardous Substances and Environmental Engineering, Vol.41, No. 5

Smyth B.M., Ó Gallachóir B. P., Korres N. E. and Murphy J. D. (2010). *Can we meet targets for biofuels and renewable energy in transport given the constraints imposed by policy in agriculture and energy?* Journal of Cleaner Production (In Press).

The Sustainable Energy Authority of Ireland (SEAI) (2009), *Energy Forecasts in Ireland to 2020 (2009 report)*, http://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling_Group

The Sustainable Energy Authority of Ireland (2009), *Energy Efficiency in Ireland (2009 report),* http://www.seai.ie/Publications/Statistic_Publications/EPSSU_publications

The Sustainable Energy Authority of Ireland (2009), *Energy in Ireland 1990 - 2008 (2009 report)*, http://www.seai.ie/Publications/Statistic_Publications/EPSSU_publications

The Sustainable Energy Authority of Ireland (2009), *Ireland's Wave Energy Resource*, http://www.seai.ie/Renewables/Ocean_Energy/Ireland's_Wave_Energy_Resource

The Sustainable Energy Authority of Ireland (2009), *Tidal and Marine Current Energy Resource in Ireland*, http://www.seai.ie/Renewables/Ocean_Energy/Irelands_Tidal_Energy_Resource/

The Sustainable Energy Authority of Ireland (2008), *Energy in Ireland 1990 - 2007 (2008 report)*, http://www.seai.ie/statistics

The Sustainable Energy Authority of Ireland (2007), *Energy in Ireland 1990 – 2006 (2007 Report)*, http://www.seai.ie/statistics

The Sustainable Energy Authority of Ireland (2007), *Renewable Energy Research and Development Document (2007 Report)*, http://www.seai.ie/Renewables/Renewable_Energy_Policy/Policy_Support_Mechanisms/13_RERDD-Overview.pdf

The Sustainable Energy Authority of Ireland (2004), *Renewable Energy in Ireland – Trends and Issues 1990 – 2002*, http://www.seai.ie/uploadedfiles/InfoCentre/RenewableEnergyinIreland19902002.pdf.

Thamsiriroj T, Murphy JD, (2008), *Is it better to import palm oil from Thailand to produce biodiesel than to produce biodiesel from indigenous Irish rape seed?,* Applied Energy, doi:10.1016/j.apenergy.2008.07.010

Appendix 1. Primary Energy Equivalent Methodology

The primary and final energy consumption for non-combustible renewable energy sources such as wind and hydro are very similar. For most fuels this is not the case, due to the energy conversion losses associated with electricity generation. Depending on the efficiency of electricity generation, typically between 25% and 55% of the energy content of the fuel input into power plants is output in the form of electricity.

The primary energy of fossil fuels and combustible renewables is defined as the calorific content of the fuel, according to internationally agreed methodologies for presenting energy statistics[42]. For non-combustible renewable sources (wind and hydro) the primary energy is equated with the quantity of electricity generated. This follows the IEA principle that the primary energy should be the first energy form downstream in the production process for which multiple energy uses are practical. This allows for harmonised international comparisons, but it does not accurately represent how fossil fuels used for electricity generation are displaced by non-combustible renewable energy. This is because, in primary energy terms, the fuel input into a fossil fuel plant is currently equated with the electricity output from a non-combustible renewable energy plant, such as a wind farm or hydro-power plant. An alternative approach is to equate the primary energy of the renewable energy with the primary energy of the fuel that would have been required to produce the equivalent amount of electricity.

This is the principle behind the primary energy equivalent (PEE) based on the partial substitution method. It requires an assumption to be made about the efficiency of the fossil fuel-based electricity generation being substituted by the non-combustible renewable generated electricity. The contribution from the renewable energy source is, in this approach, equated to the fossil fuel energy input that it displaces. The PEE for non-combustible renewable energy essentially represents the thermal fossil fuel energy avoided through the generation of renewable-based electricity. By quantifying the fossil fuel displacement achieved by renewable energy, the environmental benefits and indeed the security of supply benefits may be quantified and used to inform policy decisions.

This raises a key question however – what electricity generation is being displaced by renewable energy-generated electricity? In a previous report[43], the calculation of PEE was based on a theoretical displacement by each kWh from renewable energy of a kWh generated from the entire fossil fuel plant mix. The methodology used here draws on approaches that have been developed for use in baselining studies in credit-based emissions trading systems[44,45].

Renewable energy plants are not generally displacing electricity from either 'must-run' plants (peat) or from baseload plants (coal fired station at Moneypoint). Calculating the PEE based on the remaining plant provides a more accurate estimate than using the entire plant mix and the approach is known as the Operating Margin Approach. The assumption underpinning this approach is that the renewable plant is displacing the last plants to be dispatched to meet electricity demand, i.e. the marginal oil and gas plants. There are clear limitations in this analysis but it does provide useful indicative results.

The limitations and caveats associated with this methodology include that it ignores any plant used to meet the associated reserve requirements of renewables. These open cycle plants will typically have lower efficiency and generate increased CO_2 and NO_x emissions compared with CCGT and these emissions should be incorporated into the analysis. The purpose of presenting a simplified analysis here is to provide initial insights into the amount of fossil fuels that are displaced by renewables and the amount of emissions thereby avoided.

42 International Energy Agency (2007), *Energy Balances of OECD Countries 2004 – 2005.* Available from http://www.iea.org

43 SEAI (2004), *Renewable Energy in Ireland – Trends and Issues 1990 – 2002.* Available from http://www.seai.ie/Publications/Statistics_Publications/EPSSU_Publications/,

44 Kartha S., Lazarus M. and Bosi M, 2004. *Baseline recommendations for greenhouse gas mitigation projects in the electric power sector.* Energy Policy *32,* 545-566.

45 For further information on Ireland see Ó Gallachóir B. P., O'Leary F., Bazilian M., Howley M. & McKeogh E. J. *Comparing Primary Energy Attributed to Renewable Energy with Primary Energy Equivalent to Determine Carbon Abatement in a National Context.* Journal of Environmental Science and Health Part A: Toxic /Hazardous Substances and Environmental Engineering, Vol.41, No. 5.

Appendix 2. Policy Measures

This appendix lists existing policy measures that influence the development of renewable energy sources in Ireland.

A2.1 Carbon Tax

A carbon tax at a rate of €15 per tonne of carbon dioxide (CO_2) was introduced on fossil fuels in the 2010 budget[46]. The tax was applied to petrol and auto-diesel with effect from midnight, 9 December 2009; and from 1 May 2010 applies to Kerosene, Marked Gas Oil, Liquid Petroleum Gas (LPG), Fuel Oil and Natural Gas. The application of the tax to Coal and Commercial Peat is subject to a Commencement Order. Exemption from the tax will apply only to participants in the EU Emissions Trading Scheme (ETS) in respect of fuels so covered. On that basis, electricity is not subject to the carbon tax. One of the consequences of the carbon tax on fossil fuels is to improve the cost competitiveness of renewables. The estimated price increases due to the tax are detailed in Table 11.

Table 11 Relative Price Increase Due To the Carbon Tax

Fossil Fuel	Unit	% Increase
Petrol	litres	3.5%
Auto-diesel	litres	4.4%
Kerosene	litres	8.4%
Marked Gas Oil	litres	8.7%
LPG	litres	3.9%
Fuel Oil	litres	8.7%
Natural Gas	kWh	6.0%
Peat Briquettes	Bale	10.1%
Coal	kg	11.1%

Source: Department of Finance

A2.2 Emissions Trading

The EU emissions trading scheme came into operation on 1 January 2005. One allowance gives the holder the right to emit one tonne of CO_2 or the equivalent amount of another greenhouse gas. The scheme operates on a "cap and trade" basis. EU Governments are required to set an emissions cap for each installation in the scheme. The number of allowances allocated to each installation must be set down in the National Allocation Plan (NAP)[47] for the period in question, which must be approved by the European Commission. The first trading period ran from Jan 1st 2005 to December 31st 2007. The second trading period began on January 1st 2008 and runs for five years until the end of 2012.

A2.3 Renewable Electricity Grid Connections

The Commission for Energy Regulation[48] (CER) decides on the methodology for electricity grid connection offers. Since December 2004 renewable electricity generators wishing to connect to the transmission or distribution systems have been subject to group processing of connection applications through a series of successive "Gates". The current system in operation is termed the "Gate 3" process. This system ensures priority grid access for renewable generators. Exemptions are available for "public good" projects, subject to approval by the CER.

46 Details available from http://www.budget.gov.ie/Budgets/2010/2010.aspx and http://www.environ.ie/en/Publications/Environment/Atmosphere/

47 Available from http://www.epa.ie/downloads/pubs/air/etu/NAP2%20_Final%20_Allocation%20_Decision_040320082.pdf

48 Commission for Energy Regulation website: http://www.cer.ie/

A2.4 Renewable Energy Feed-in Tariff for Electricity Generation

In May 2006 a new market mechanism for renewables was announced as a successor to the alternative energy requirement scheme (AER) which was based on power purchasing agreements at prices determined by auction. The new market mechanism is a renewable energy feed-in tarriff (REFIT)[49]. The initial categories supported were large scale wind (>5MW), small scale wind (<5MW), Hydro (<5MW), Biomass landfill gas (LFG) and other Biomass. The renewable energy feed-in tariff (REFIT) scheme was extended to include Offshore Wind, Ocean Energy and Bio-energy Combined Heat and Power (Bio-Energy CHP) new plant from 1 June 2008 . This support mechanism is to help meet the national target of 15% of all electricity to come from renewable energy sources by 2010 and 40% by 2020. The support levels are linked to the consumer price index. A summary of the scheme is shown in Table 12. The support for any particular project cannot exceed 15 years and may not extend beyond 2030.

Table 12 REFIT Scheme Support Levels

REFIT Reference Prices	c/kWh	Announced
Wind <5 MW	5.9	01/05/2006
Wind >5 MW	5.7	01/05/2006
Hydro <5 MW	7.2	01/05/2006
Biomass LFG	7	01/05/2006
Other Biomass	7.2	01/05/2006
Biomass CHP	12	24/01/2008
Anaerobic CHP	12	24/01/2008
Offshore Wind	14	08/02/2008
Wave	22	15/01/2008

Source: SEAI

A2.5 Electricity Transmission System Upgrade Plan — Grid 25[50]

The development of the electricity transmission system is critical in order to achieve the Government RES-E target of 40%. Eirgrid, the Irish transmission system operator, calculates that to facilitate the necessary increase in renewable generation and to adequately meet the demands of the electricity customer, the capacity of the bulk transmission system will need to be doubled by 2025. The full strategy for developing the transmission system is presented in Eirgrid's Grid 25 document.

A2.6 Interconnection

The development of interconnection between the All-Island Electricity Grid system and other grids, for example Great Britain and Europe, is considered necessary in order to facilitate exporting renewable electricity. The East-West interconnector between Ireland and Britain is due to be operational by 2012. Investigations are ongoing into other possible interconnectors to either the UK or France. Eirgrid state in their Grid 25 development plan that it is likely there will be at least one other interconnector by 2025. Ireland is also being considered for inclusion in an off-shore supergrid along with other northern EU countries and Norway.

A2.7 Small and Micro Scale Electricity Generation Programme

In April 2008, a new small and micro scale electricity generation programme[51] was initiated. The programme is assessing technical, financial and regulatory issues surrounding the deployment of small and micro generation technologies in Ireland. This includes a review of market arrangements required to encourage small and micro scale generation uptake, the definition of quality standards for products and installers, and a pilot trial and monitoring of 42 installations. ESB Customer Supply offer a domestic micro-generation rate[52] of €0.09 per kWh with the addition of €0.10 per kWh available for the first 3000 kWh exported to the grid annually for up to 4000 domestic wind, PV, micro CHP and hydro generators for the next three years (2009 to 2011), which will be paid over a five-year period.

49 See http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Sustainable+and+Renewable+Energy+Division.htm

50 Available from http://www.eirgrid.com/media/Grid%2025.pdf

51 The small and micro scale electricity generation programme is a grant support scheme administered by SEAI. See http://www.seai.ie/Grants/Microgenpilot for details.

52 Details available from https://www.esb.ie/esbcustomersupply/residential/energy_efficiency/micro_generation_tariff.jsp

A2.8 CHP Deployment Programme

The CHP Deployment Programme[53], due to run over the period 2006 to 2010, provides grant support to assist the deployment of small-scale (<1 MWe) biomass CHP systems. The programme provides funding for CHP systems (including anaerobic digestion and wood residues) and includes funding for feasibility studies for micro-CHP generation. The objective of the trial is to assess current technology and identify possible barriers, risks and benefits associated with its deployment.

A2.9 Planning Permission Exemptions for Renewable Energy Technologies

Planning exemptions for micro-generation renewable energy technologies were introduced for domestic[54] purposes in 2007 and other buildings[55] in 2008. The exemptions apply to wind turbines, solar panels, heat pumps and biomass subject to certain conditions in each case.

A2.10 Building Regulations (Part L Amendment) Regulations 2008[56]

Since July 2008, all new domestic buildings are required to have the following contribution from renewable energy:

- 10 kWh/m^2/annum contributing to energy use for domestic hot water heating, space heating or cooling, **or**
- 4 kWh/m^2/annum of electrical energy, **or**
- a combination of these which would have the equivalent effect.

A requirement for a quantified amount of energy from renewable for non-domestic building is not specified in the 2008 building regulations Part L - buildings other than dwellings. However it is stated that consideration should be given to the use of renewable energy, e.g. solar water heating, and to heat recovery from other processes, where applicable.

A2.11 Greener Homes Scheme Phase II

Phase II of the Greener Homes Scheme[57] was launched on 1 October 2007. The intention of the scheme is to stimulate consumer investment in renewable heating solutions and to develop the market for renewable technologies and fuels, thereby reducing CO_2 emissions in the domestic sector. Phase II includes a range of new objectives including heightened product standards and improved training standards across the industry. The Greener Homes Scheme provides assistance to homeowners who intend to purchase a new renewable energy heating system for an existing house, which first occupied prior to 30 June 2008.

A2.12 Renewable Heat Deployment Programme (ReHeat)

In order to facilitate meeting the national target specified in the Government White Paper of 5% of all heat to come from renewable energy sources by 2010 and 12% by 2020 a Renewable Heat (ReHeat) Deployment Programme[58] was launched in March 2007. The programme provides assistance for the deployment of renewable heating systems in industrial, commercial, public and community premises in Ireland. The heating systems covered by this grant scheme are boilers fuelled by wood chip or wood pellets, solar thermal systems and heat pumps.

A2.13 Bioenergy Establishment Scheme[59]

This scheme provides establishment grants to farmers to plant willow and miscanthus to produce biomass suitable for use as a renewable source of heat and energy. The scheme provides establishment grants of up to €1,300 per hectare or 50% of the cost. The scheme was initially launched on a pilot basis in 2007 and supported the planting of 2,500 hectares by the end of 2009. €1 million is being made available to support the planting of a further 1,000 hectares in 2010.

A2.14 Wood Biomass Harvesting Machinery Scheme[60]

The Department of Agriculture and Food has introduced a scheme of support grants to assist the development of the supply chain required to process and supply wood biomass to end-users.

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53 The CHP deployment programme is a grant support scheme administered by SEAI. See http://www.seai.ie/Grants/CHP for details.
54 Statutory Instrument No.83 of 2007. Available from http://www.irishstatutebook.ie/home.html
55 Statutory Instrument No.235 of 2008. Available from http://www.irishstatutebook.ie/home.html
56 Available from http://www.environ.ie/en/DevelopmentandHousing/BuildingStandards/
57 See footnote on page 21.
58 See http://www.seai.ie/index.asp?locID=1114&docID=-1 for details.
59 Dept. of Agriculture and Food (2007) , BioEnergy Scheme for Willow and Miscanthus. Available from http://www.agriculture.gov.ie/farmerschemespayments/otherfarmersschemes/bioenergyscheme/
60 Dept. of Agriculture and Food (2007), Wood Biomass Harvesting Machinery Scheme. Available from http://www.agriculture.gov.ie/contentarchive/forestry/woodbiomassharvestingmachineryscheme/

A2.15 Bioenergy Action Plan

The Bioenergy action plan[61] was launched in March 2007, based on the work of a ministerial task force in which six government departments were represented, as well as the Office of Public Works (OPW). The plan contains 50 action items to help develop Ireland's bioenergy resource. Specific tasks were identified for each department and the OPW to promote bioenergy in the transport, heat and electricity sectors as well as bioenergy research and development. The Bioenergy Working Group established by the Department of Communications, Energy and Natural Resources (DCENR) will report to the Renewable Energy Development Group (REDG) in 2010 with implementation plans to achieve the targets established in the Bioenergy Action Plan.

A2.16 Biofuels Mineral Oil Tax Relief (MOTR)

The Biofuels MOTR scheme II[62] was designed as an interim measure to increase the level of biofuels in the fuel mix and to encourage the development of an indigenous biofuels industry. It was introduced in the 2006 Budget as a five-year scheme. There are four categories in this scheme: Biodiesel(EN590), Pure Plant Oil, Bioethanol and biofuels in captive fleets. Since the start of scheme II there has been a steady increase in biofuels used in Ireland.

A2.17 Biofuels Obligation Scheme

The Energy (Biofuel Obligation and Miscellaneous Provisions) Bill 2010[63] is currently subject to Oireachtas approval. It is expected to come into effect from July 2010. The Bill will place an obligation on fuel suppliers to ensure that biofuels comprise 4% of the volume of their supplies, equivalent to approximately 3% in energy terms. The scheme will be administered by the National Oil Reserves Agency (NORA) at no cost to the Exchequer. It will be a key component in achieving the EU target of 10% penetration of renewable energy in transport by 2020.

The Bill attaches an important condition: that biofuels must come from sustainable sources as defined by Article 17 of the Renewable Energy Directive (2009/28/EC). Compliance with the biofuels obligation scheme can be met with tradable certificates. Biofuels produced from biodegradable or residue will be issued with two certificates per litre whereas all other biofuels will receive one certificate per litre.

A2.18 Electric & Hybrid Vehicles

The 2008 Finance Bill[64] provides relief for hybrid, electric and flexible-fuel vehicles of up to €2,500 for cars registered between 1 July 2008 and 31 December 2010 on the vehicle registration tax (VRT) payable, in addition to the benefit of the 2008 annual motor tax (AMT) CO_2 system. Businesses can write off 100% of the cost of purchase against tax under the Accelerated Capital Allowance scheme.

From January 2011 full battery electric cars will qualify for financial support[65] of up to €5,000, and plug in hybrid for up to €2,500, depending on the vehicle cost.

A2.19 Accelerated Capital Allowance Scheme

The Accelerated Capital Allowance Scheme[66] (ACA) was introduced in the Finance Act 2008. The scheme enables businesses to write off the entire cost of a specified set of energy efficient technologies include renewable energy technologies in the first year of purchase (including electric vehicles and micro-generators).

61 Available from http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Report+for+website.htm
62 Details available from http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Biofuels+Scheme+II/
63 Details available from http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Biofuels+Obligation+Scheme.htm
64 Details available from http://www.budget.gov.ie/Budgets/2008/2008.aspx
65 Details available from http://www.seai.ie/News_Events/Press_Releases/Electric_Cars_a_Reality_for_Ireland.html
66 Details available from http://www.seai.ie/Your_Business/Accelerated_Capital_Allowance/

A2.20 Business Expansion Scheme (BES)

Business Expansion Tax Relief[67] is a tax relief incentive scheme that provides tax relief for investment in certain corporate trades. Investments in renewable energy qualify for BES relief. Budget 2007[68] announced that the scheme was being renewed from 1 January 2007 for a seven year period to 31 December 2013. Individual investors holding a BES equity investment for a minimum period of five years can benefit from tax relief, at their marginal rate, in respect of investments of up to a maximum of €150,000 per year.

A2.21 Corporate Tax Relief for Investment in Renewable Energy Generation

Section 486 Corporate Tax Relief came into effect in 1999. Corporate equity investments in certain renewable energy projects are eligible for tax relief[69] in the form of deduction from a company's profits for an investment in new ordinary shares in a qualifying company. Budget 2007 announced that the qualifying period for the scheme of tax relief for corporate investment in certain renewable energy projects was being extended from 31 December 2006 to 31 December 2011.

Statutory Instrument 98 of 2009[70] brings into operation the provisions of section 51 of the Finance Act 2007. This section extends the qualifying period for relief under section 486 B of the Taxes Consolidation Act 1997 to 31 December 2011. To qualify for the relief the energy project must be in the solar, wind, hydro or biomass technology categories, and be approved by the Minister for Public Enterprise (now the Minister for Communications, Marine and Natural Resources). The investment in respect of which relief can be given is capped at the lesser of 50% of all capital expenditure or €9.525 million for a single project. Investment by a company or group is capped at €12.7 million per annum and unless the shares are held for at least five years by the company the relief will be withdrawn.

A2.22 Renewable Energy Research, Development & Demonstration

In August 2002, SEAI launched the Renewable Energy RD&D programme[71]. The focus of the programme is to stimulate the application and further deployment of renewable energy technologies, particularly those close to market viability. The programme was allocated an indicative budget of €16 million.

A2.23 Irish Energy Research Council — An Energy Research Strategy for Ireland

The energy research strategy 2008-2013[72] focuses on the approach that should be taken towards basic and applied research to underpin new energy conversion, distribution and end use technologies. The strategy describes the rationale and proposed strategic actions for major areas of research activity including Ocean Energy and Sustainable Bioenergy.

A2.24 Science Foundation Ireland

It was announced in May 2008 that the Government was formally extending the remit of the Science Foundation Ireland (SFI) to incorporate the areas of sustainable energy and energy-efficient technologies. SFI's role is to build a capacity of highly-skilled researchers in the area of research underpinning sustainable energy and energy-efficient technologies and integrate with the research strategy prepared by the Irish Energy Research Council.

A2.25 Charles Parsons Energy Research Awards

The Minister for Communications, Marine and Natural Resources announced the establishment of the awards[73] in 2006. The awards are designed to develop and stimulate overall energy research capacity, particularly in certain priority areas. They provide funding for research groups active in energy research and research training; in particular, full-time researchers, PhD scholarships for engineering graduates and summer student placements.

67 Details available from http://www.revenue.ie/en/business/reliefs-incentives.html
68 Details available from http://www.budget.gov.ie/Budgets/2007/2007.aspx Ibid
69 Details available from http://www.revenue.ie/en/business/incentives/renewable-energy-generation-taxrelief.html
70 Available from http://www.irishstatutebook.ie/home.html
71 Details available from http://www.seai.ie/Renewables/Renewable_Energy_Policy/Policy_Support_Mechanisms/13_RERDD-Overview.pdf
72 Details available from http://www.dcenr.gov.ie/Energy/Office+of+the+Chief+Technical+Advisor/Irish+Energy+Research+Council.htm
73 Details available from http://www.dcenr.gov.ie/Energy/Parsons_Awards_Advert.htm

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